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Volume 8, Number 7, July 1987

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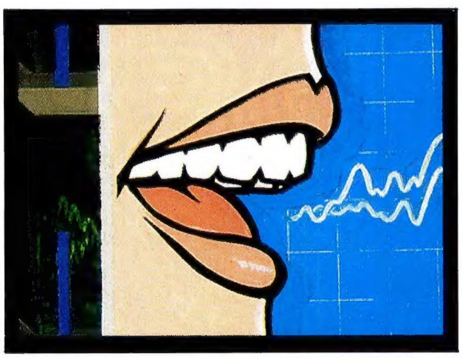

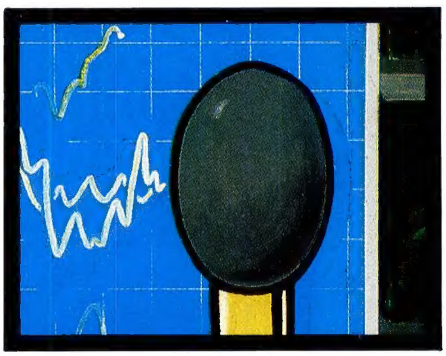

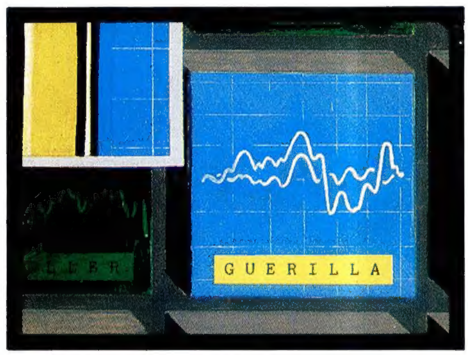

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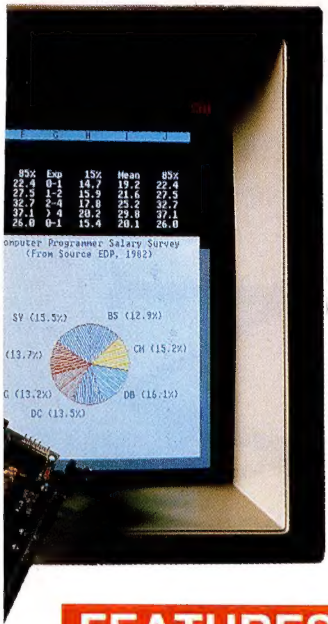

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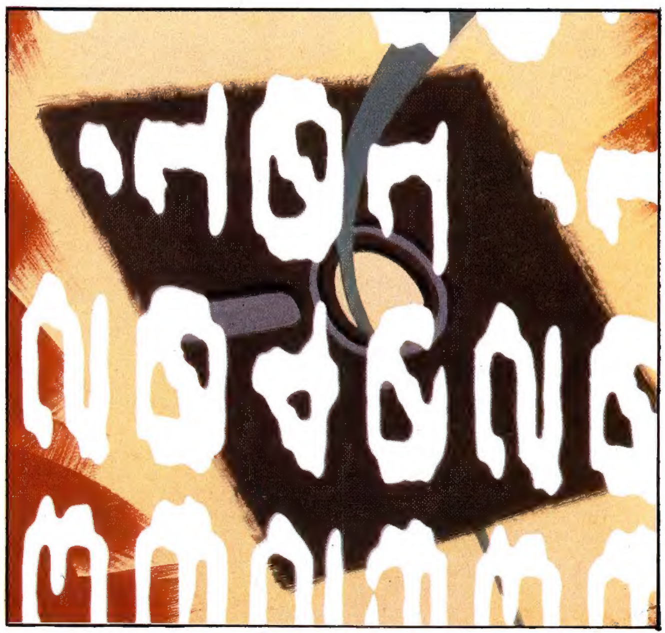

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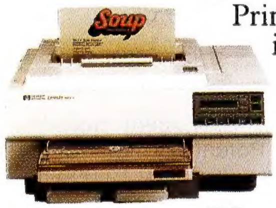

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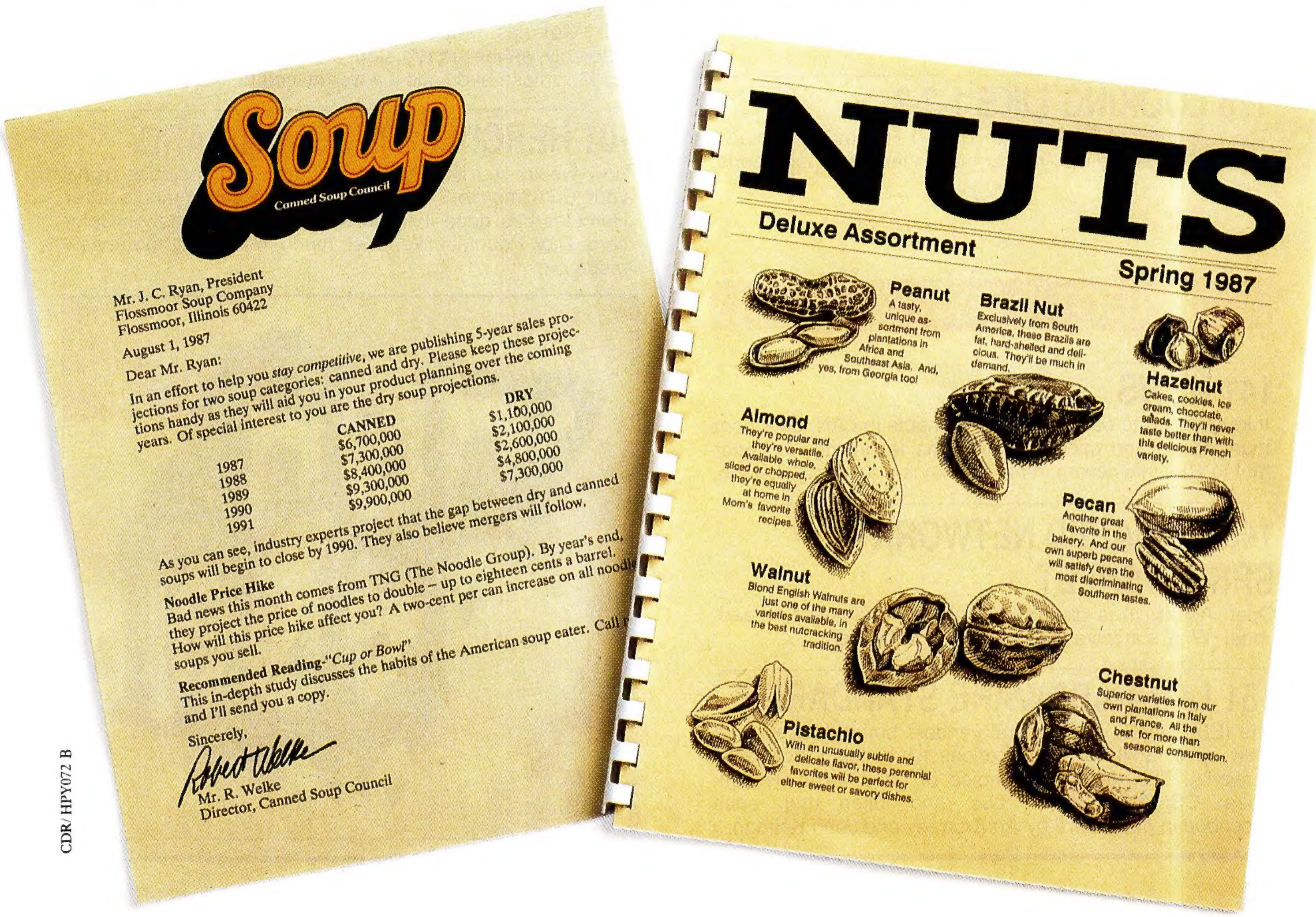

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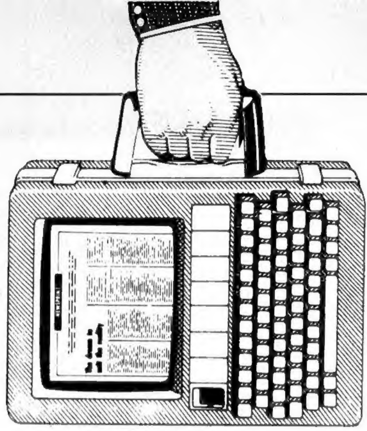
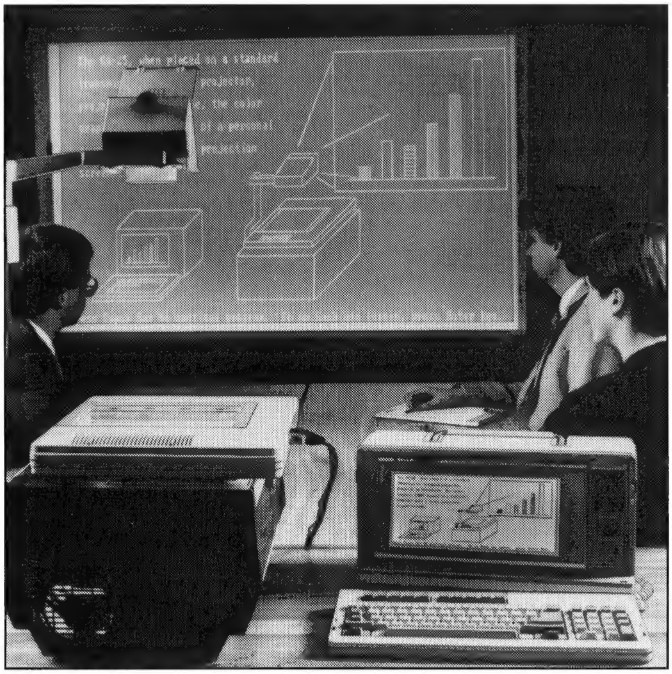


NEWSPRINT

Guy Kewney and associates present this month's collection of interesting bits and pieces from around the computer world . . . including new add-in products for Lotus users, a portable Mac from Apple, challengers to Microsoft's DOS and false advertising claims from a clone distributor.



Now this is clever: it's essentially an LCD screen, which instead of containing its own light source, has a transparent back. So when it's placed over a standard over-head projector, the image pattern of the screen is displayed through the projector.

If you look closely, you'll see that the image these people are seeing on the wall is the same as on the Portable PC in the bottom right hand corner of the photograph.

The device is from Sharp and is called the QA25 Overhead Projection Panel. It plugs into the standard monitor port on IBM PC-compatibles and the Apple IIe and sells for $1795.

Call Sharp on (02) 831 9111 for more details.

Atari just window shopping

Atari is *not* going to take over Inmos, the British-based Thorn-EMI subsidiary which makes the Transputer.

Having got that straight, let's look at recent events which might have made it seem possible that Atari would even consider such a move. Let's start with the recent Atari Show.

"There is a limit to the number of times Jack Tramiel can pull a rabbit out of a hat, before people notice it's always the same rabbit," commented one attentive Atari watcher after the show.

What he was noticing was that since Atari launched its first 68000-based ST — the 'Jackintosh' machine, which was going to destroy the Macintosh — it has made several other announcements. But nearly all of these are simply of other ST models with a bit more memory. The rest are video games machines which it had to stock when it crashed under Warner, or upgrades to those, or 8-bit machines like the 800 and the 600 and the 1200, which are over five years old.

What he was also noticing was that Atari has no semiconductor plant, no disk manufacturing plant, and no American presence. In short, Atari in June 1987 is a one-trick pony. It is all front and no substance; it is a cash mountain made out of paper money, waiting to blow away in the first real wind.

At first sight, that isn't fair. The show featured an amazing amount of new software games, and even some quite serious business software. There was the announcement of the laser printer, and there was the launch of the IBM PC compatibles.

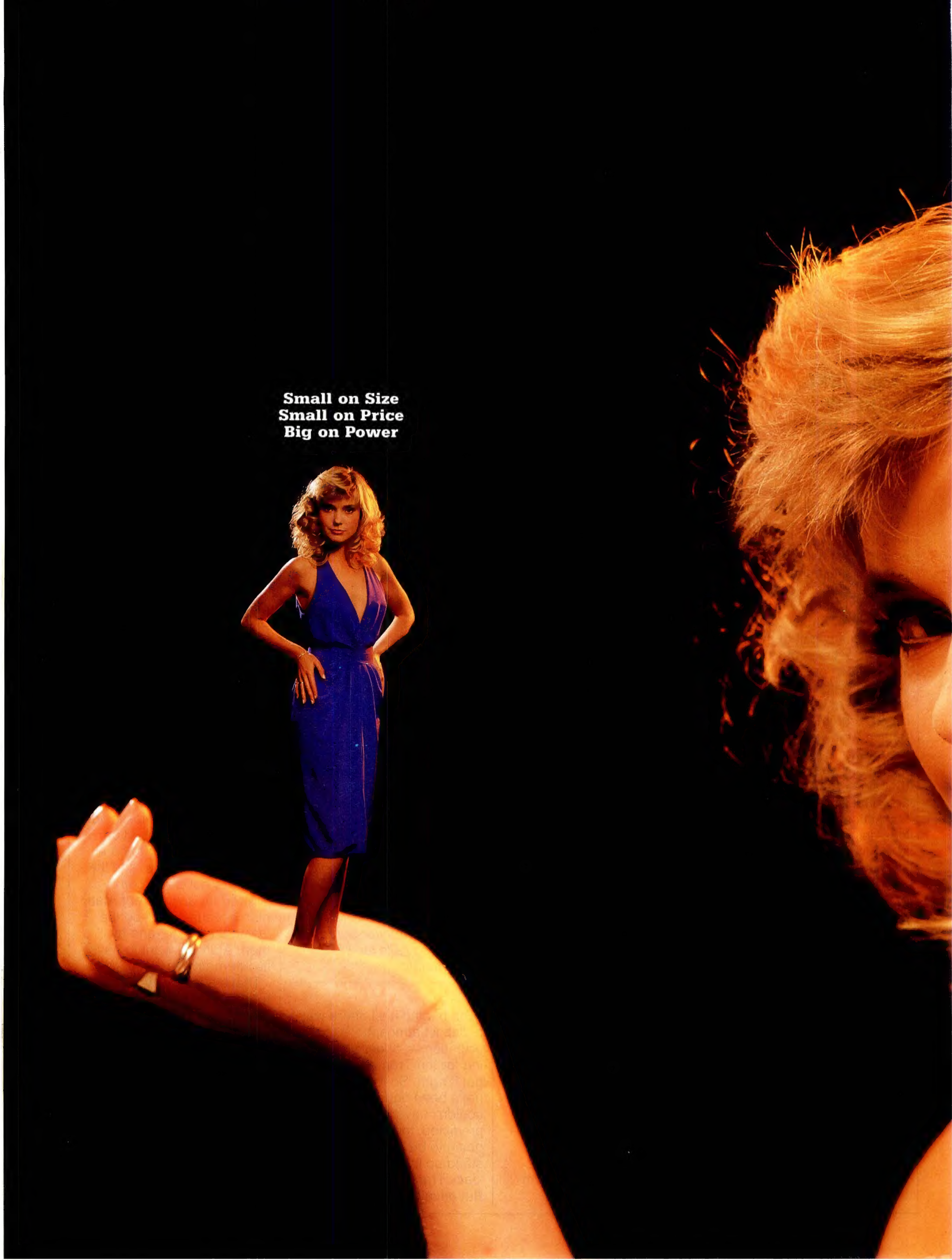
But behind it all, there was a distinct atmosphere of anticipation — of people waiting for the Tramiel family to get it right. So many things have been done which couldn't have been predicted, that no-one is going to be brave enough to stand up in public and say 'Jack Tramiel is blowing it.' But privately there are anxious moments, when they will admit that they do wonder whether things are really going quite as well as they looked when the first STs appeared.

In particular, the questions that need serious answers are: 'When will the laser printer be ready, and working? When will the Mega STs be available? If the PC was virtually ready for launch back in January, where is it? Where is the Unix machine?' And above all: 'Where are we going from here?' The answer is: new chips, and new software.

The STs are not the last word in technology. They are nice-enough boxes, properly priced for what they are and likely to be around for five more years yet. But Motorola has pronounced sentence on the chips inside them. The Atari based on the 68020 is going to be a multi-user machine, and the 68030 is not being considered for any current Atari plan because it will be the last in the range, and by then, Atari will want to have its alternative in place.

That's a long way into the future. So far, in fact, that it seems silly to start worrying in public about how Atari will cope. And yet . . . when is the next rabbit going to come out?

A hint about the 'next rabbit' was given in this column last month, when I reported on negotiations between Atari and a designer of Inmos Transputer-based machines.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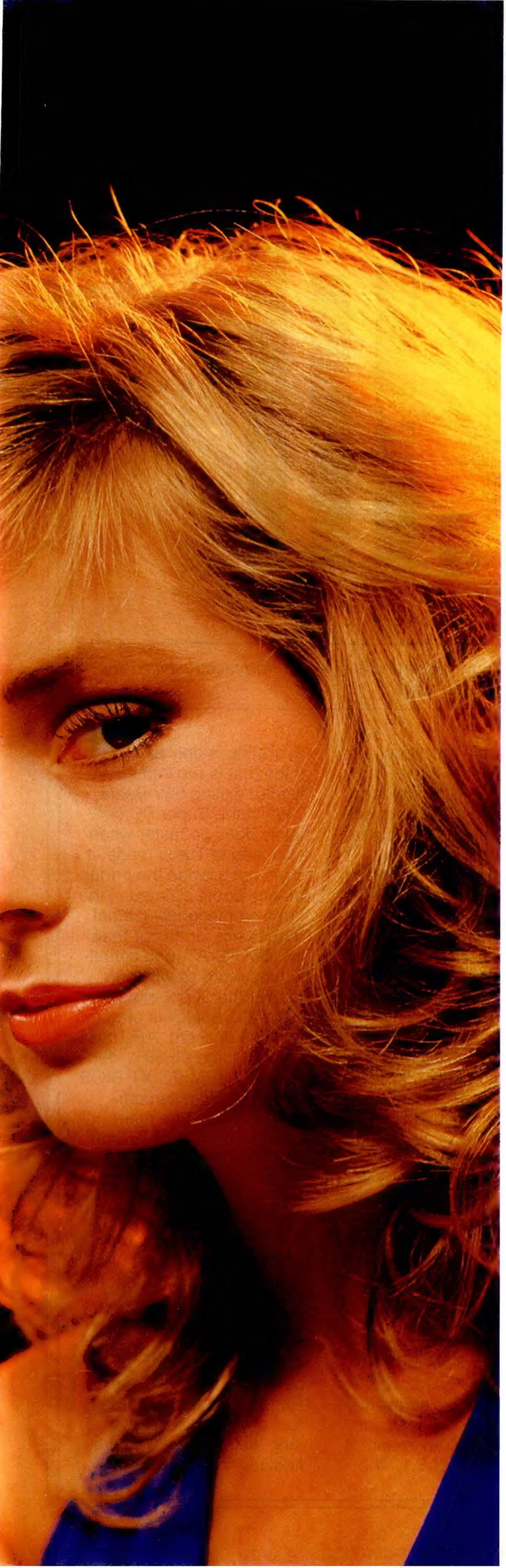

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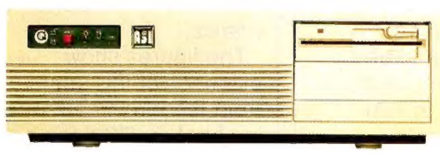

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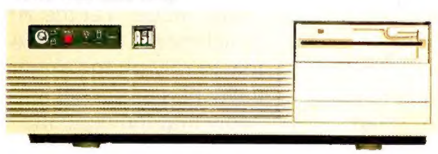

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a slight 'tardiness' in character-by-character communications. This is caused by the overhead of wrapping individual characters one to a packet, and the round-trip delays. The end result was that in typing a line of text, the echo would 'lag' slightly behind the keystrokes as they were pressed. This phenomenon tends to happen anyway in very long haul communications, with lags of up to thirty seconds occasionally being experienced to the US via satellite.

Over very good quality lines, another interesting effect is that the bottleneck may not be the modem, but the PC. During file transfers, the line may return to idle several seconds before the PC reports the transfer to be complete. In other words, the modems have finished transferring the data, but the receiving modem has been maintaining a buffer because the PC cannot accept the data fast enough.

Inside

Clearly it takes some quite extraordinary gear to provide all this functionality and performance, so you may not be surprised to learn that this modem sports a Motorola 68000-10 CPU plus Texas Instruments 32010 signal processor. Added to these are 100k of RAM and 64k of PROM. Then there are all those bits you expect to find in a modem, including a 'World Modem' chip.

The rear of the unit provides a 25 pin RS-232C port, power, line-in and phone-out connections. The power supply is a separate unit providing 18v of AC output. This feeds into the modem case where the power is rectified and passed through a whopping Nat Semi voltage regulator mounted on a hefty heat sink. Next to it is a large 3300uf capacity which is probably best left alone just after operation. A small horizontally mounted fan keeps the air circulating. The phone-out jack allows a normal telephone receiver to be 'piggy-backed' off the modem for voice operation.

> *'the fun and games which software can play to compensate are often less than adequate, and often not available'*

The line-in jack leads to a separate line isolation unit. This unit optically isolates the modem from the Telecom phone system, and contains a relay, opto-isolators, power supply and not much more. The isolator is driven from a separate 'plug pack' power supply. All in all, it adds up to quite a handful of gear.

Despite being sold by an Australian modem manufacturer, the modem (as you may have guessed from the above) is not Australian. The Trailblazer was designed and manufactured in the US by Telebit Corporation, and NetComm makes no bones about it. Unlike many 'golden screwdriver' companies claiming very high Australian content, NetComm says "No, it's not an Australian modem. We do build modems in Australia, and know what it means to really build something.

"Sure, we assemble them, but we don't call that Australian made".

Very refreshing. Lots do.

The line isolation unit is Australian made, as is the bundled software and software manual, but NetComm isn't making any song and dance about Australian content. Perhaps one day they might license the technology from Telebit and commence local manufacturing.

Performance

Performance, of course, varies. A range of tests was made using Melbourne to Sydney lines during business hours. Several connections were made to ensure a variety of lines. The Trailblazer was able to report through-

Call scope	Tx bps	Rx bps	File size	Seconds	Retransmits	Bytes/sec
Melb-Syd	12,994	13,067	51,672	50.8	0	1,017
Melb-Syd	15,184	15,768	51,672	42.9	1	1,204
Melb-Syd	8,176	13,651	51,672	80.7	16	640
Local	18,031	18,031	51,672	34.4	0	1,502
1200bps	1,200	1,200	36,456	394.0	0	93

Table 1 Measurements of Trailblazer throughputs

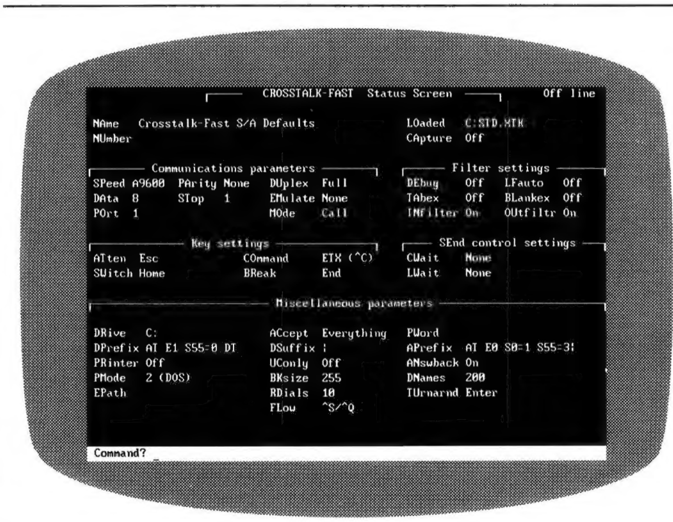


Fig 1 Crosstalk-fast enhanced status screen

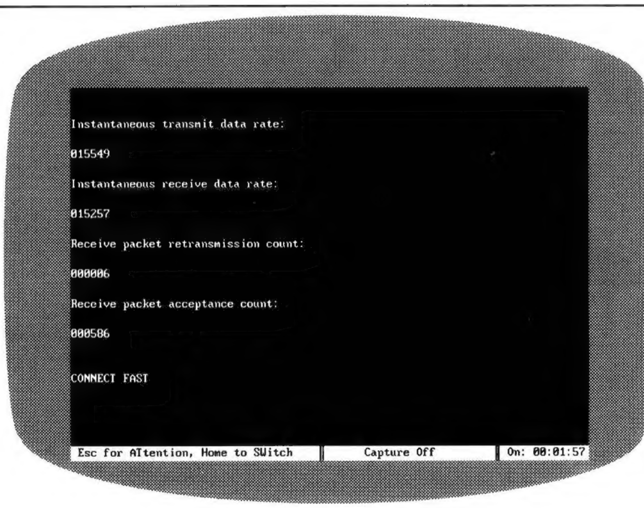


Fig 2 Trailblazer displaying line status

depends on which, who, where, and when, for decisions to be taken in advance.
Guy Kewney

Wake up, Lotus

Like religious zealots, Lotus has taken to its logical extreme its own belief that unprotected software may not be used (see last month's piece on the lawsuits). It has stamped on a company which provides a way of unprotecting Lotus 1-2-3 and Symphony.

The company, Trisoft, sold Unlock in two forms, to cope with these products. Mainly, these things were bought by people who had a legitimate copy of Lotus 1-2-3, but didn't like having to put their original into the floppy drive to start the program up every day.

Illicit copying of software is a worrying trend, and I have no doubt that the arrival of the cheap clone buyer has increased it. But making protected software is not the answer, and it really is time Lotus woke up. Soon, it will be too late.
Guy Kewney

Expanded memory for '286 PS/2

Users who have delayed purchasing IBM's PS/2 Models 50 and 60 because of the absence of boards that meet the Lotus/Intel/Microsoft Expanded-Memory Specification (LIM EMS) for those machines may soon have a solution that uses IBM hardware.

Vericomp, a small PC memory-products company based in San Diego, is close to announcing an EMS software driver for IBM's 80286 Memory Expansion Option, according to a source at Vericomp. The 80286 Expanded Memory Option is a board that fits into the motherboard of the PS/2 Models 50 and 60, allowing the addition of up to 2Mbytes of memory per board. PS/2s can be configured with four Memory Expansion Option boards for an additional 8Mbytes of memory.

The driver, dubbed LIMbo, is a high-speed expanded-memory manager that makes use of an unpublished page-mapping capability of the IBM 80286 Memory Expansion Option, according to the Vericomp source. The product represents the first expanded memory solution on the PS/2s.

LIMbo was developed by Vericomp under contract with Borland International. Vericomp hopes to retail it for $US49.95, according to the company source.

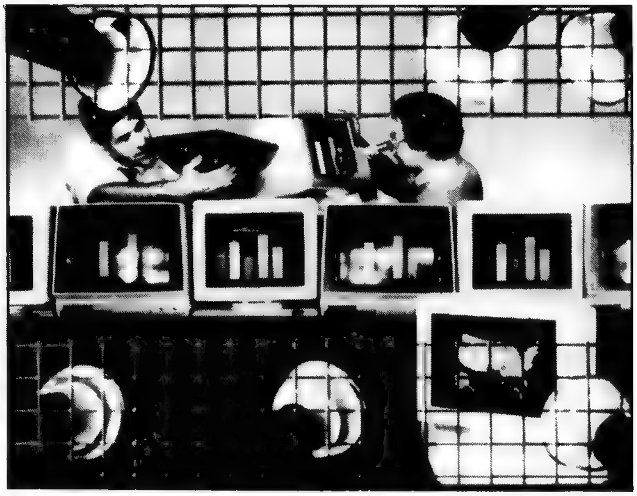
Antonio Salerno, OEM sales representative at Borland, confirmed the existence of the product, but said a marketing agreement between Borland and Vericomp had not been formalised as of last month.

The EMS software driver was developed at Borland's headquarters prior to the PS/2 announcement, with information provided by IBM, according to company President Philippe Kahn. Borland will sell the driver to software developers on an OEM basis, Mr Kahn said.

The driver will also be included with Borland's Reflex, a database program, a Borland spokeswoman said.

This same driver was listed in IBM's PS/2 Software Compatibility Guide as 'EMS Toolbox' from Borland. In a footnote, the product is described as supporting the "Lotus/Intel/Microsoft Expanded-Memory Specification for IBM Personal System/2 Model 50 and 60 equipped with IBM Personal System/2 80286 Memory Expansion Option."

According to Borland's Mr Salerno, the product was neither officially named nor available to users at the time IBM published the compatibility guide.



Flatter than any colour TV yet seen, this new display from Zenith is totally flat, has amazingly high resolution, and is compatible (says the company) with the new video VGA standard for IBM's System/2 micros.

Can you get it? No! It will start being available some time soon through Zenith's own computer outlets, on Zenith systems, and the company wouldn't even quote a price at press time.

But is has to be seen to be believed, and Zenith assures me that when it is readily available, the price will be 'very similar' to IBM's new display prices.

Steal one if you can't buy one. They're amazing.
Guy Kewney

The only memory-expansion software announced by IBM for PS/2s are the 3270 Workstation Control Program and OS/2, to ship in the fourth quarter.

Board makers clashing with IBM

IBM's PS/2 Micro Channel bus architecture requires that all peripheral boards be assigned an identification number to take full advantage of the hardware to work properly. But in their haste to bring products to market, board makers are selecting their own PS/2 ID numbers. And according to IBM officials, putting out boards with unregistered numbers may be putting users at risk.

"There can be diagnostic problems or system crashes" if more than one board in a machine is given the same ID number, warned an IBM spokesman.

Board makers, on the other hand, charge that IBM's bureaucracy is too slow in assigning identification numbers.

"Getting an ID number from IBM seems to be as common as a clam with legs," said David Keene, an engineer with systems developer Tecmar. "We've been telephoning and waiting for a positive response from them for 10 days."

Board makers say they have no alternative but to choose their own numbers from the lists that appear in the PS/2 technical reference manual or borrow one from IBM PS/2 board products already on the market.

The ID numbers allow boards to take advantage of the intelligent bus structure of the PS/2 Micro Channel — the ability to automatically identify the characteristics of add-in boards connected to the machine's bus. This eliminates the need for jumpers and dip switches that users have had to set

The less chips on the board the better. 28% less will do nicely.

Higher resolution means sharper characters. More brilliant colors. And more information on the screen.

Does the card work with your current software? It should.

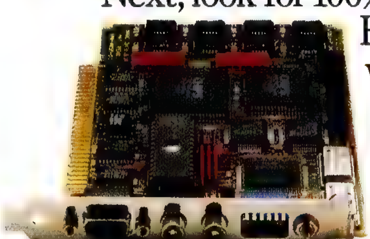
If you count the pixels, you should come up with 640 by 480. And 752 by 410.

How to choose an EGA card.

First and foremost, look for high resolution. At least 37% higher than "standard" EGA.

Like the resolution you get with the new VEGA Deluxe™ card. (Remember, though, for more than 640 x 350, you'll need a Multi-Sync® or equivalent monitor.)

Next, look for 100% compatibility with every other video standard: EGA, CGA, Hercules and MDA. As well as an autoselect capability when used with compatible monitors.



Make sure you choose a short card. Like the VEGA Deluxe.

Naturally, the card should include high-resolution drivers for Microsoft Windows, Lotus (with 120 columns and 43 lines), for 1-2-3 and Symphony. And software support from packages like AutoCAD, Windows, GEM, Dr. Halo, EASYCAD, EGA Paint, In·A·Vision, Windows Draw and Windows Graph. And, of course, a full two year warranty. All of which you get with the VEGA Deluxe.

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on previous generations of PC add-in boards.

dBase work-alike upgraded

WordTech Systems is releasing a new version of its Quicksilver dBase compiler that will offer both higher speed and added compatibility with WordTech's dBase clone, according to company officials.

The new version of the Quicksilver dBase compiler, release 1.1, has been revamped to provide faster performance and compatibility with new features of the WordTech dBXL dBase workalike, company officials said. dBXL, introduced in February, is a $250 program that offers performance comparable to Ashton-Tate's dBase III Plus, but includes more sophisticated programming features for designing user interfaces.

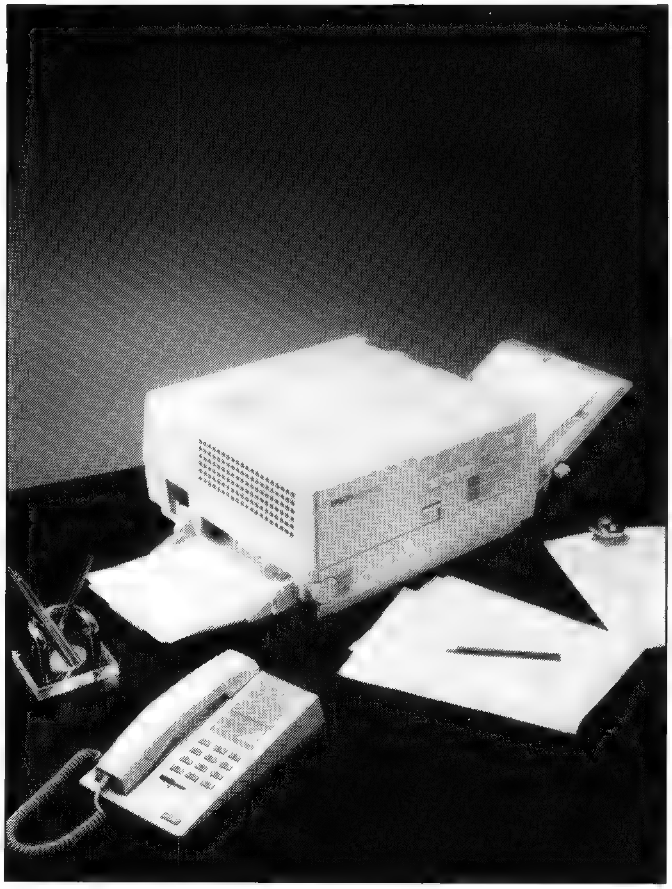
"WordTech added new things in dBXL that Quicksilver did not address," explained Adam Green, a consultant who specialises in database technology and is the author of several books on dBase. "This new release retrofits Quicksilver to take advantage of the features of dBXL, giving WordTech the advantage of delivering both an interpretive language and a compiler to end users."

Since most companies competing for the dBase-compatible market offer either an interpreter or a compiler, WordTech's ability to offer a compatible set puts it in a unique position, according to Mr Green. Currently, Quicksilver has an installed base of 15,000 users, according to company officials.

Other new capabilities of Quicksilver 1.1 include a feature for sorting database records by phonetic words instead of spelling, as well as support for building applications with overlays.

The new Quicksilver release also supports dBXL's windowing features so users can compile programs that incorporate layered windows and context-sensitive help screens, Mr Van Voorhis added.

Mr Van Voorhis also said that the company will soon introduce a new version of dBXL that supports the networking syntax of Ashton-Tate's dBase III Plus, allowing users to build networked database applications. Currently, Quicksilver supports multi-user capabilities, but it only allows users to execute applications on a network after they have been developed, he said.



The world's leading printer manufacturer has stepped into the laser market with its GQ-3500.

It's pretty standard in most respects, but includes an LCD status display (giving the 'you're about to run out of toner' sought of warnings). Probably its biggest drawcard will be Epson's name. And rightly so.

Call Epson on (02) 452 5222 for more details.

CrossTalk upgrade released

After months of delay, CrossTalk Communications has begun shipping CrossTalk Mk 4. The long awaited PC communications program supports 15 simultaneous communications sessions and includes CrossTalk Application Support Language (CASL).

Les Freed, president of CrossTalk, said the delays were caused by additional enhancements not previously announced; these include IBM 3278, 5250 and 5290 terminal emulation, allowing the software to work with Digital Communications Associates' IRMA and Smart Alec add-in coax boards.

"This was a brave new world for us. It required us to go back and rework some of the previous code," said Mr Freed.

CASL is a programming language that allows users to write programs for custom applications and to automate communications sessions. Also, CrossTalk Mk 4 supports several popular file-transfer protocols including XModem, YModem and Kermit.

Million dollar dBase upgrade

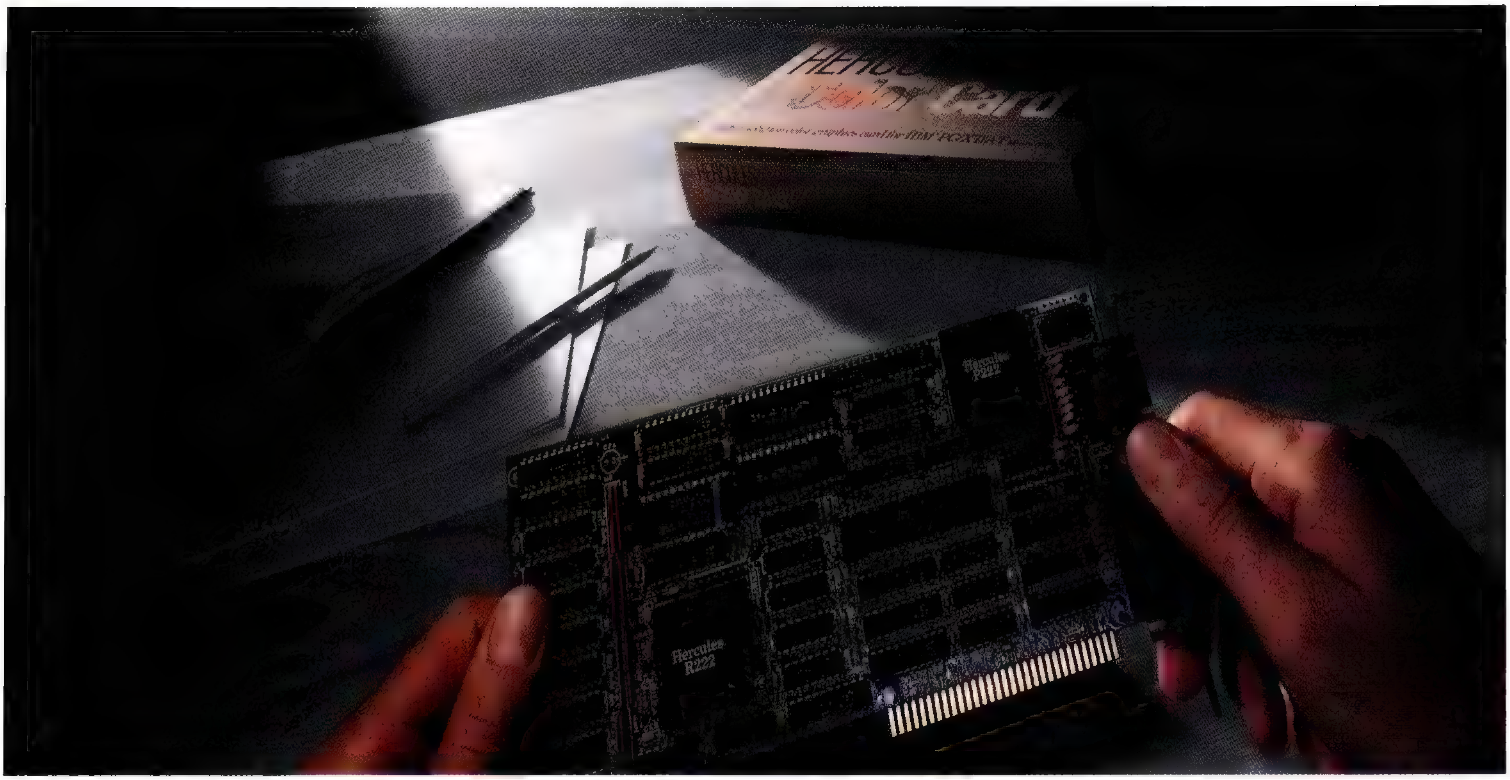
Ashton-Tate is shifting its new dBase development effort into high gear in the hope that a new version of the program will be ready for shipment by the end of the year, according to sources close to the project.

Users have faulted dBase — which has not been upgraded for nearly two years — for lacking the added performance and advanced language features found in the new crop of dBase clones and compilers, such as Nantucket's Clipper and Fox Software's Foxbase.

In addition, dBase does not support the Structured Query Language (SQL) built into the growing number of PC databases based on minicomputer and mainframe programs.

To speed the process, the sources said, the company last month finalised a set of specifications and a development schedule and has also established a cash bonus of more than $US1 million for the programming team to ensure the product which is intended for DOS is completed by September.

"The bonus plan is a new thing for Ashton-Tate; they are using it as a negotiating tool in return for the programmers meeting their benchmarks," said one source close to the project. "They are finally getting



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Hercules Computer Technology, 2550 Ninth Street, Berkeley, CA 94710. Ph: 415 540-6000. Telex: 754063. Fax: 415 540-6621. Trademarks/Owner: Hercules, In Color, RamFont/Hercules; Lotus, 1-2-3, Symphony, Manuscript/Lotus; Microsoft/Microsoft; AutoCAD AutoDesk; IBM/IBM.

more of a centralised strategy instead of a research free-for-all and are going to buckle down and meet their objectives."

According to sources familiar with the development effort, performance is the primary objective for the next dBase, which is referred to internally as either the Manhattan or Nova project.

While the new release will not include a separate compiler, it will make use of internal buffering and caching schemes to speed its execution time, making it about 80 per cent as fast as the fastest dBase alternative on the market, one source said.

In addition to speed enhancements, extensions to the dBase language currently found in most of the compilers and work-alikes — for example user-defined functions and the ability to create windows — are to be addressed in the new version of dBase, several sources said.

Kurzweil OCR price breakthrough

Kurzweil Computer Products (KZP) has announced PC-based intelligent character-recognition (ICR) scanning system, called discover 7320, which company officials claim will redefine the price/performance ratio in the PC scanner market.

Because of their artificial-intelligence capabilities, ICR scanners have traditionally been priced in the $100,000 range.

Discover, however, will begin shipping in the US on July 1 for $US9,950. Company officials claim Discover runs at an average of 60 characters per second, which is comparable to many of the higher-priced scanners.

Along with its low price and high-performance capabilities, Discover is designed to run in background mode, allowing the user to work in other PC applications, such as word processing, while scanning takes place in the background.

In addition, because of its ICR capabilities, Discover provides 'omnifont' recognition — the ability to recognise with a high level of accuracy virtually any font or format in a document. The new scanner will recognise any font from 8 to 24 points in size, company officials said.

Discover consists of a proprietary coprocessor board with ICR software scanner, interface card, 2Mbytes of memory and a desktop scanner. The board inserts into a single slot on an IBM PC XT or AT or compatible.

Any documents produced by offset press, laser printer, typesetter, letter-quality dot matrix and other non-impact printers, as well as daisy-wheel and other impact printers and typewriters, may be scanned by Discover.

The user interface consists of a simple menu-driven command line format; an on-line option is available. Full user documentation and a 'quick start' tutorial accompanies the scanner.

Kurzweil plans to market Discover through resellers, value-added resellers and OEMs.

Program compiles 1-2-3 templates

A Lotus 1-2-3 worksheet compiler that will allow developers to produce worksheets that optimise recalculations and limit user access to formulas has been introduced by

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By using RamFont to display smaller-than-standard characters, 1-2-3 Release 2 gives you a spread-sheet that shows almost twice as much data as before.

And, RamFont makes scrolling instantaneous and smooth, rather than painfully slow and jerky.

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Word 3 was the first PC word processor that let you see boldface, italics, subscripts and superscripts mixed with regular text.

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Manuscript is Lotus' new technical word processor, written to run optimally on the Hercules Graphics Card Plus.

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Besides these dramatic improvements, RamFont also dramatically improves the scrolling speeds of Symphony® 1.1 and Framework II.™

For WordStar,® there's a RamFont add-on that lets you use multiple fonts.

There's even a new word processor that lets you write in Greek, Russian and Hebrew, *on the same screen.*

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And our high-resolution text mode that runs thousands more programs.

Here are a few of the programs taking advantage of RamFont.

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Which, on top of the Plus' performance, has caused a few people in the industry to get unusually excited:

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John C. Dvorak,
PC Magazine *columnist.*

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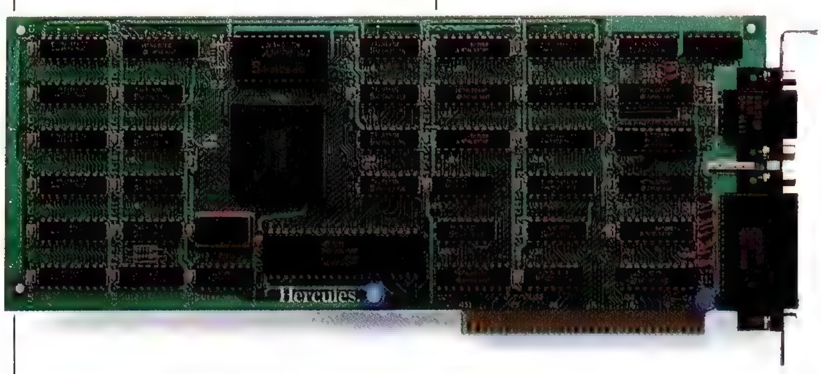

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SoftLogic Solutions. Called @Liberty (pronounced 'at liberty'), the compiler enables developers to produce worksheet templates as they would using the 1-2-3 spreadsheet, according to Ed Tolson, company president. They then compile the worksheet file using the @Liberty Prepare program, and to use the compiled worksheet later, users run a program called Run.

When running the compiled worksheets, users can access only cells that do not contain formulas, text or numbers. This, according to the company, keeps users from accidentally altering formulas that could change the results of their data.

This safeguard is particularly attractive to Mark Fastert, president of @Liberty betatester Professional Planning Consultants, of Chicago in the US. Mr Fastert helps his clients assess their pension plans. "I can give my clients an executable Liberty worksheet along with Run to allow them to see how their pension program is going to work," he said.

"[@Liberty] won't let them change formulas, so I can be sure their results are accurate," he added.

The compiled worksheet recalculates faster than 1-2-3 because it only calculates cells that are affected by the revision to the worksheet, according to SoftLogic.

With the purchase of the first copy of @Liberty, which costs $US99, users are permitted to make 10 copies of Run.

More Run copies can be made in 15-user increments for $US99

SoftLogic is also offering a $US495 licence that will allow users to make unlimited copies of Run. This would be useful in large companies or for developers of vertical-market template packages, according to SoftLogic.

For the user, the @Liberty screen is similar to the standard Lotus screen, with its rows and columns. The menu items are limited to 'non-development' commands, such as file saving and graphing. @Liberty can compile files produced from Lotus look-alike programs, such as Daybreak Technology's Silk, according to Mr Tolson. It is compatible with 1-2-3 version 1a and, according to Mr Tolson, can handle 'most' of the functions of version 2.

The program will also convert 1-2-3 macros to provide an automated process for data entry.

Add-ins for 1-2-3

Turner Hall Publishing has added to its line of Lotus add-in products Spellin!, an add-in spelling checker for Lotus 1- 2-3 version 2.0 and 2.01 and Symphony 1.2, and Note It Plus, a spreadsheet-annotation utility for Lotus version 2.0 and 2.01.

Spellin! allows users to check specific cells, ranges, entire spreadsheets or documents for spelling errors, said Tom Byers, general manager at Turner Hall, a division of Symantec Corp, maker of the Q&A database/wordprocessor. If an error is detected, the users select the correct entry from a list of alternatives presented in a window.

Prerelease versions of the spelling checker take up slightly more than 95k bytes of memory. Because the program was developed using Lotus Development Corp's add-in tool kit, Spellin! can be detached from memory from within 1-2-3 or Symphony when it's not in use, returning the 95k bytes to the user, Mr Byers said.

In addition to Lotus and Symphony files, Mr Byers said, the spelling checker

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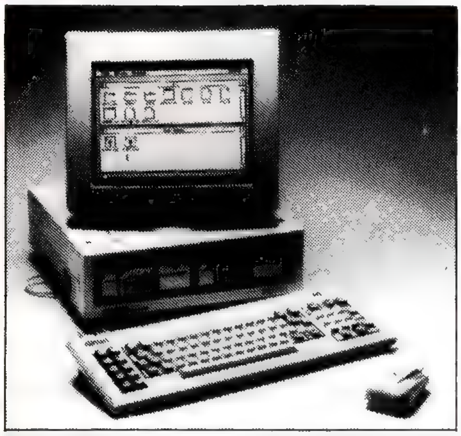

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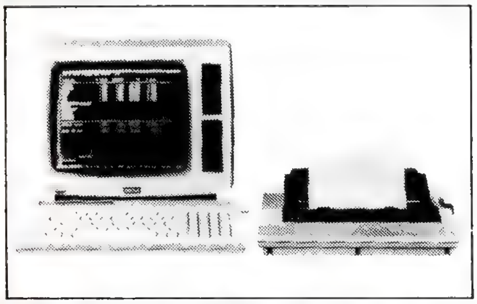

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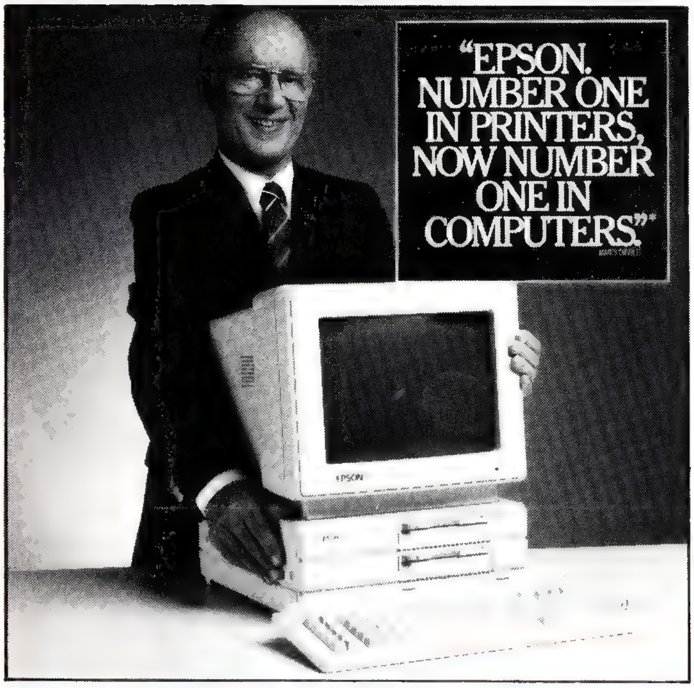

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will also work with word processing documents created using add-in word processors such as Turner Hall's 4Word, as well as cell-annotation utilities.

Spellin! also allows users to create custom dictionaries containing lists of words that may be unique to specific vocations. Users can choose from one or two dictionaries — American or British English — supplied with the program, Mr Byers said.

Spellin! will be available July 1 and will cost $US79.95. Unfortunately no Australian price had been set by its local distributor, Intelligence Australia, at press time. Call Intelligence on (02) 699 3877 for details.

Note-It Plus, Turner Hall's new release of its cell-annotation program Note-It, provides users with the ability to browse, link, search and copy information from one cell to another, Mr Byers said.

The browse command allows users to jump from one annotated cell to another using either the cursor-control keys or the PC's Tab key. Note-It Plus's search command allows 1-2-3 users to search for numerical values or ASCII text strings and cell notes as well as .WKS worksheet files.

The Note-It Plus link command allows users to join cells and provides additional room for users to explain how numbers in a spreadsheet have been derived.

The fourth addition to Note-It Plus is a copy-paste function that allows users to move information within a spreadsheet, Mr Byers said.

The two most important features in Note-It Plus could be the browse and link features, said Robert Ayers, an accountant who has used the new program. "Being able to quickly browse through a spreadsheet, and to explain in great detail how numbers have been derived, is a tremendous asset for people who have to deal with large spreadsheets," he said.

Note-It Plus sells for $118.80 and is also available from Intelligence Australia.

Developers search for pieces

The 600 programmers who attended Microsoft's Operating System/2 developers' conference last month discovered, upon opening their 35-kilogram tool kits, that there is still a lot of pieces missing from the protected-mode operating environment heralded by both Microsoft and IBM as the future of microcomputing.

For starters, a version of OS/2 that takes advantage of the unique memory and multi-tasking features of the 80386 chip is at least two years off, Microsoft officials said.

More critical for most attendees was the fact that code for the Presentation Manager — a graphical user interface based in part on Microsoft Windows — which is needed to write full-featured OS/2 applications, will not be available until the fourth quarter of this year.

Many developers said that it would take them a year after that to get their applications out the door. Nevertheless, the mood was upbeat, and most of the programmers were eager to cut their teeth on OS/2, no matter how distant the payoff.

Microsoft warned that the tool kit contained prerelease code and would be 'buggy'. Developers who had a chance to start experimenting with the software discovered some of the deficiencies right away.

Most notably, the current OS/2 code has a fairly limited set of device drivers, and Microsoft's documentation only assures that it will run on IBM ATs and 80286 and 80386 PCs from Compaq and Zenith. Most surprisingly, it does not run on the PS/2s, and Microsoft gave no indication of when PS/2 support or even 3.5in disk copies of the software would be available.

OS/2 presently will not run on the Intel InBoard or other '386 add-on boards. "Things have to be fairly strictly AT-compatible," said Steven Ballmer, Microsoft vice president of systems software. Some developers even reported problems booting OS/2 on IBM ATs, as only a limited number of hard-disk device drivers are included.

Roughly 65 per cent of the programmers attending the conference were independent software developers, with the remaining 35 per cent from corporations doing in-house development, according to Mr Ballmer.

Those numbers are reversed, however, in the registrations for Microsoft's subsequent seminar in New York, he said — user/developers represent one half of the programmers buying the tool kit for OS/2.

Many of the programmers who developed OS/2 were available for lengthy question-and-answer sessions. OS/2 is sufficiently complex for several engineers to be needed to field certain questions.

The concerns voiced by the audience of developers ranged from the minutiae of how to get started to more

strategic questions such as, "What are we going to do with OS/2 and how soon do we have to do it?"

OS/2 presents developers with a range of choices, as there are different methods of programming for the environment depending on the facilities the developer wishes to use.

For example, developers who are more concerned with offering generic PC software than with taking advantage of OS/2 can write what IBM and Microsoft refer to as 'Family' applications — programs that are portable between the OS/2 and DOS 3.3 environments.

Such programs would have the functionality of a DOS 3.3 application and would not take advantage of the ability to access memory beyond 640kbytes, the multitasking facilities of OS/2 or the Presentation Manager. The Family applications tools, however, do give developers the option of writing programs that work in either environment.

Other issues addressed at the conference included migration to a '386 operating environment. While a '386 version of OS/2 is years off, Microsoft spokesmen stressed that OS/2 would run on '386 PCs.

Moreover, applications written to OS/2 now would run under '386 OS/2, although they will require modification to fully utilise the new operating system.

More near-term enhancements to OS/2 will include a reworking of the file system, which presently retains DOS's 32Mbyte disk limitation, said Gordon Letwin, Microsoft's chief architect for systems. The next file system will be unlimited in size and more efficient and will include support for CD ROM (Compact Disk, Read Only Memory) and WORM (Write Once/Read Mostly) drives, he said.

Mysteries of Micro Channel unfold

A demonstration last month of an IBM PS/2 Model 60 running two 80286 processors provided users with a glimpse of the as-yet-untapped power of the IBM Micro Channel architecture.

At the Comdex/Spring trade show, IBM for the first time publicly showed a prototype expansion card for the Model 60 containing an auxiliary 10MHz 80286 processor that operated inde-

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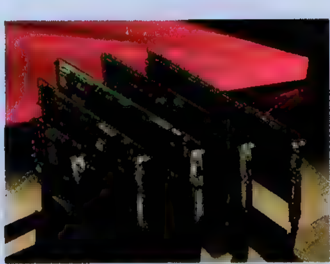

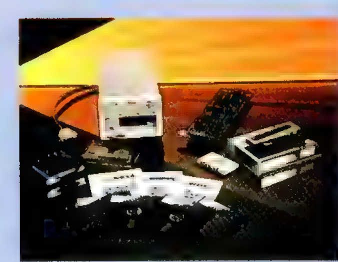

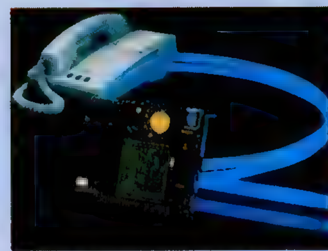

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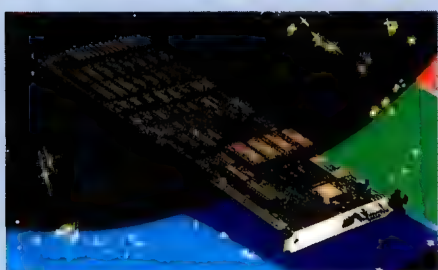

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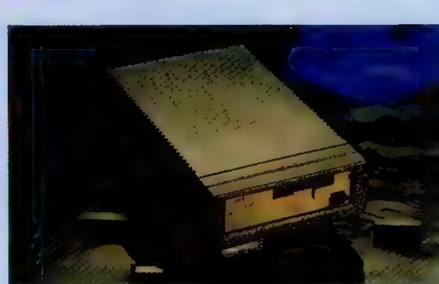

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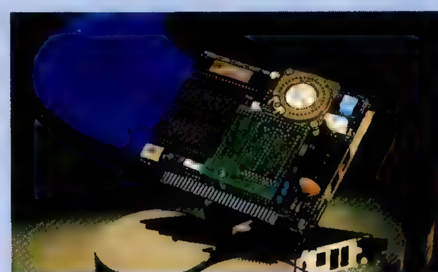

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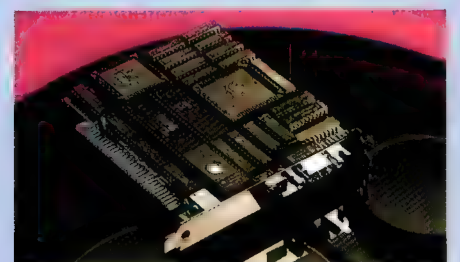

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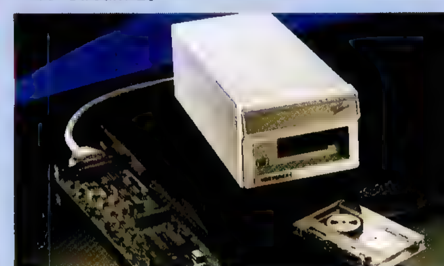

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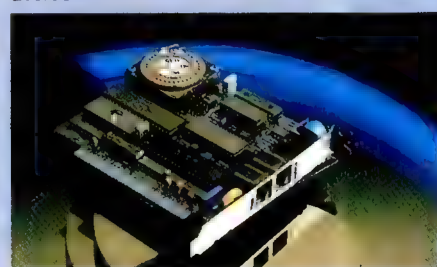

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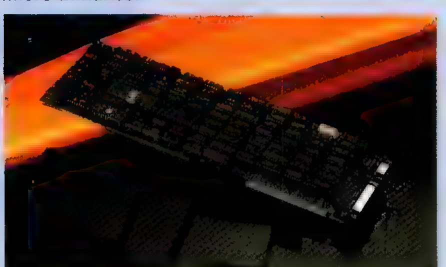

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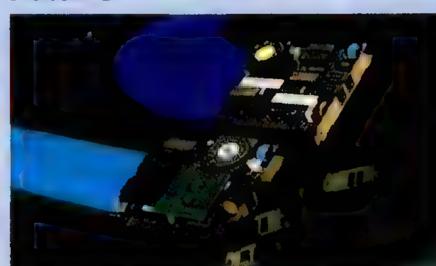

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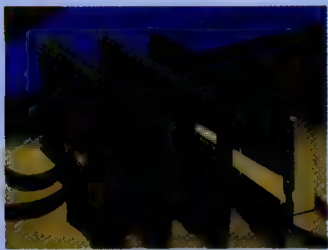

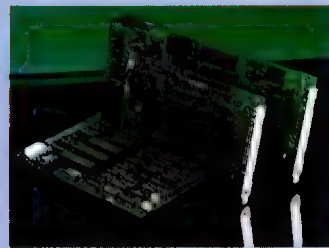

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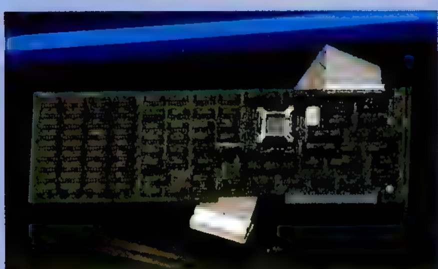

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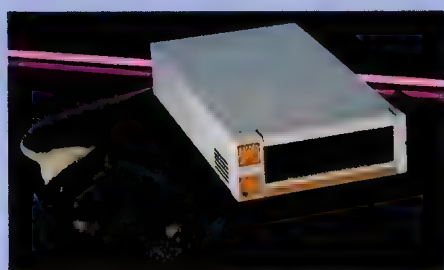

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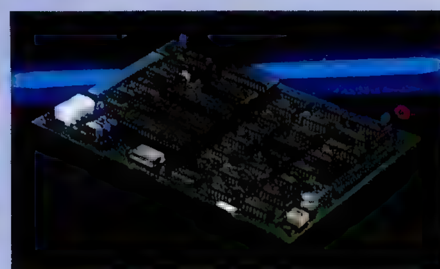
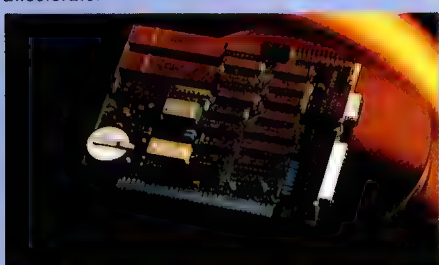
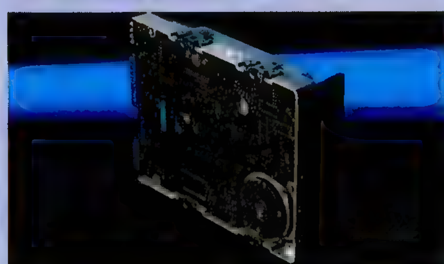


EV-826



Magic I/O



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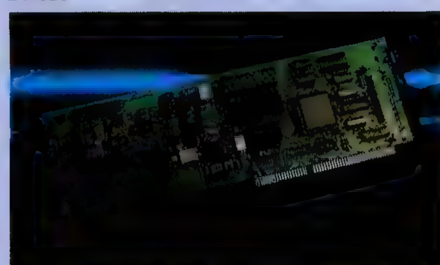

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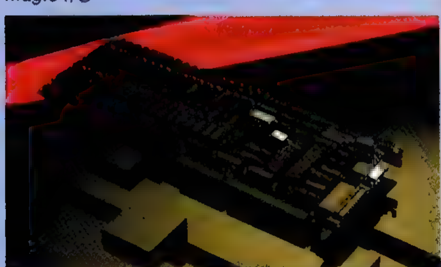

Magic Card 16

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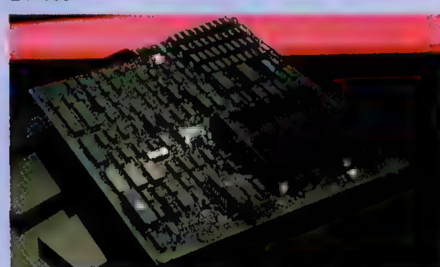

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pendently of the motherboard's CPU, also a 10MHz 80286.

The Micro Channel design can support a total of 16 intelligent processors and easily manage requests from those devices, said Chet Heath, one of IBM's computer scientists who helped design the Macro Channel architecture used on the Model 60 and 80.

The dual-processing abilities demonstrated last month take the potential of the Models 60 and 80 one step further by providing users with a method of independent, concurrent processing. This means that the PS/2s can either conduct several computing sessions simultaneously — with no performance degradation — or harness the power of several coprocessors for a single computing task.

These concurrent processing capabilities of IBM's Model 60 and 80 will be very important for future applications, said Mr Heath, and could lead over time to 'the development of personal supercomputers.' This processing 'will allow users to develop mainframe-like systems that are based on the OS/2 architecture,' he said.

Potential applications that could take advantage of the Micro Channel's ability to support up to 15 additional processors include graphics, artificial intelligence, fault-tolerant computing, using the PS/2 as a controller for storage devices connected to mainframes, asynchronous communications and local area network controllers, Mr Heath said.

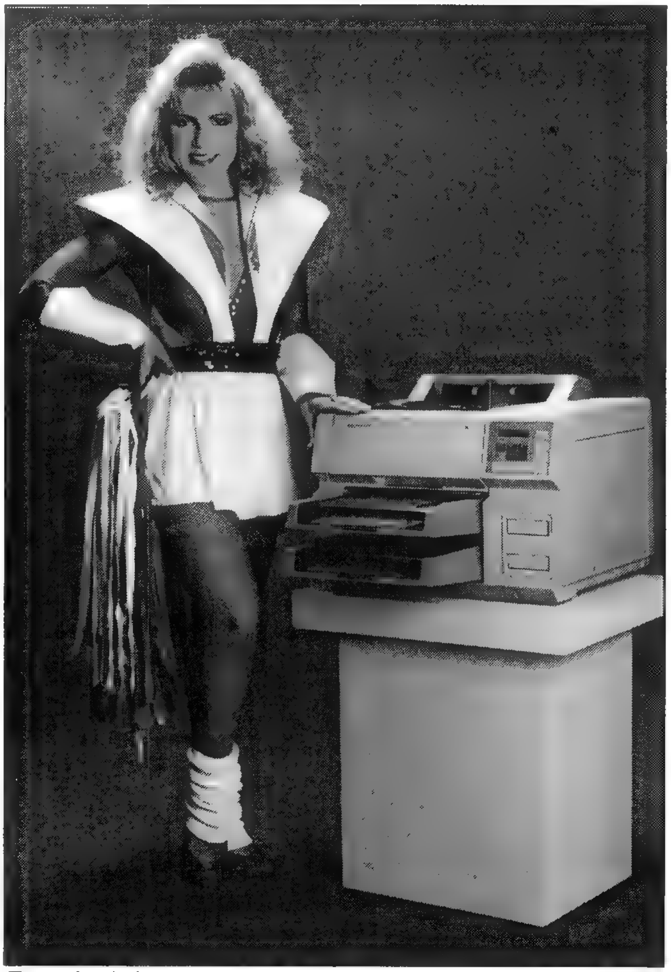
CPUs attached to the Micro Channel need not be compatible with one another, which will allow board manufacturers and software makers to develop cards that could, for example, allow a Motorola 68000 processor to share the same bus as an Intel 80386 and 80286.

Another feature important to concurrency implemented on the Micro Channel is IBM's Fairness Algorithm, which prevents any one processor from monopolising the bus at the expense of any other device, Mr Heath explained.

By comparison, the bus in existing ATs and PCs has no defined way of controlling multiple intelligent devices that contend for access to the bus, and it can't prioritise requests. Also, in older IBM PCs and ATs, coprocessors are configured as slave devices, and the PC's bus will not support more than one slave processor.

"In the old [PC and AT] bus, there was no way [for multiple microprocessors] to effectively work together on the same bus," Mr Heath said.

With the Micro Channel, on the other hand, multiple CPUs can be configured as peers or multiple masters, Mr Heath explained.



Every body is getting into laser printers this year, even those of the Sydney Swanettes.

Apart from this confidence-inspiring support from Sydney's finest (who, according to the PR firm responsible, Concise Communications, contributed to make TI's laser printer launch the "biggest, brassiest media spectacular held in Sydney this year"), the most notable feature of this laser is the option of the PostScript page description language.

Call TI for further details.

New Microsoft DOS interface with menus

Instead of giving DOS a gold watch and a farewell pat on the back, Microsoft has given it a pacemaker in the form of a new user interface that replaces the familiar 'A>' prompt with pull-down menus.

Last month Microsoft, with some help from Zenith Data Systems unveiled the easy-to-use interface for DOS, called the MS-DOS Manager, which will be marketed by PC makers, rather than Microsoft.

Zenith is the first OEM to bundle the interface with a personal computer. The company also intends to sell MS-DOS Manager as a stand-alone software package for about $US50 beginning in August, said Sharon Segall, Zenith's product marketing manager for PC products.

At press time, Zenith's Australian representative, Anitech, had no knowledge of the product so we can't offer you local prices or availability. However by the time you read this, Anitech should have information, so give them a call if you're interested.

The MS-DOS Manager user interface is similar to that of Microsoft Windows, with pull-down menus, dialogue boxes, mouse support, and similar function keys and menu structures. and like Windows, it allows users to load applications from within the MS-DOS Manager and return to this environment automatically upon exiting a program.

"For the casual PC user, this is clearly the best type of interface — it simplifies the use of a PC," said Bob Dilworth, Zenith Data Systems' president.

MS-DOS Manager is based on character graphics — graphics that use only the predefined character set available on the machine — and does not use bit-mapped graphics, which must be drawn on-screen pixel by pixel.

By not using bit-mapped graphics, the MS-DOS Manager runs faster than Windows — which does use bit-mapped graphics — on lower-powered, 8088-based machines, said Adrian King, Microsoft's director of product marketing for operat-

ing systems. MS-DOS Manager is not a substitute for Windows, company officials insisted. It is primarily a file-and-applications manager. Windows offers a broader range of capabilities, including multi-tasking, dynamic data exchange between applications and a complete graphics interface.

Nonetheless, the MS-DOS Manager offers many of the same features as the MS-DOS Executive application found in Windows.

Tiny firm has rival DOS

Wendin, a tiny, family-owned software company, is challenging IBM and Microsoft's system software with Wendin-DOS, a 'homebrew' operating system that Wendin officials claim is compatible with DOS 3.x, more capable and timely than OS/2, and cheaper than both.

Wendin-DOS runs all popular MS-DOS software and offers multi-tasking and multi-user capabilities as well, according to Zane Troester, Wendin's director of marketing. The new operating system is scheduled to start shipping in August and will retail for $US99.

Wendin's operating system replaces MS-DOS and is similar in concept to the multi-tasking DOS 4.0 that Microsoft developed but never seriously marketed. Both Wendin-DOS and DOS 4.0 can run on 8088 or 8086-based machines, but they neither break the 640kbyte memory limit nor take advantage of the protected mode of the 80286 and 80386 microprocessors.

"We think there is a niche between DOS 3.2 and OS/2," said Mr Troester. "We want to offer a product that can do what OS/2 can do on existing [8088-based] hardware. It's like DOS 4.0 but better."

In a novel approach to software development, Wendin has tapped an unusual, but powerful, resource to help it in its battle with the industry giants. It is enlisting the help of hackers and hobbyists, charging only $US20 for beta-test versions of Wendin-DOS, and sponsoring a contest with a $US500 first prize for the programmer who identifies the most bugs and makes the most helpful suggestions for improving the products' functionality and compatibility with MS-DOS.

Apparently the company's unusual approach is paying off. "We have over 1000 beta testers signed up and [we're] receiving really detailed reports and suggestions from all sections of the industry, including engineers at large corporations who have bought the program with their own money and are working on Wendin-DOS in their spare time," said Mr Troester.

Wendin is rating all this attention because compatibles makers are looking for a cheaper alternative to licensing DOS and a company that is easier to deal with, Mr Troester claimed. "Maybe they are just a little fed up with Microsoft," he said.

Wendin is a 3-year-old company specialising in operating system development tools.

The company may be reached through PO Box 3888, Spokane, Washington, USA 99220-3888 (509) 624 8088.

Cards target PC desktop publishing

Several software and hardware manufacturers are developing PC add-in boards that will let users turn a PC into a desktop-publishing workstation. Included on the multi-function boards are the controls for laser printers and monitors as well as the firmware for page-description languages.

This new breed of multi-function cards, which are expected to be available this year, will allow users to save valuable expansion slots in their PCs and avoid the cost of purchasing separate controller cards for each publishing-related peripherals, according to several users and developers who have seen the new boards.

The products include a yet-to-be-announced controller from Phoenix Technologies and ConoDesk 6000, a controller from Conographic which company officials announced earlier this month.

"The Phoenix board brings together PC desktop publishing and the publishing of business presentation graphics," according to one software company executive who asked not to be identified.

"It drives the printer and the monitor on one board. That means you can run a high-resolution monitor with EGA and page-description languages for desktop-publishing output. Then you can link a slide maker or video recorder and share the features of one PC board for different applications."

Conographic's ConoDesk 6000 can be configured to include ConoScript, Conographic's version of Adobe Systems' PostScript page-description language. It includes a high-speed controller that speeds the operation of the laser printer to which it connects. Other controllers can be added to the board to run such things as monitors and PC facsimile boards, according to Joseph Mechi, Conographic's vice president of business development.

The Phoenix board includes Phoenix's compatible version of PostScript, a parallel port for laser printers and a graphics controller to run high-resolution monitors, such as NEC's Multi-Sync.

Also included is an EGA chip set (to run software that is written to the EGA standard), the Texas Instruments 34010 graphics controller (which speeds processing of graphics images created on the screen) and enough memory to store and create fonts, several sources explained.

Intel expects shortfalls for '386

Buyers of Intel's 80386 microprocessor are feeling the pinch resulting from a manufacturing problem first discovered last month. The company has put existing customers on strict allocation and is not accepting any new orders for the chip.

"There will be major [production] shortfalls in the second and third quarters," said Intel spokesman Bruce LeBoss. "Everybody is going to feel the pain, and that includes Compaq, IBM and Intel itself. Nobody is getting what they wanted."

Mr LeBoss said Intel is asking customers with acknowledged orders to re-evaluate their requirements and resubmit their orders.

The actual allocation for each company, which "varies all over the map," said Mr LeBoss, is based on a combination of factors that includes the place a customer held in the original order queue, the size of the order and the customer's past relationship with Intel.

"This could hurt the clone companies who were counting on '386-based AT-class machines to give them a performance advantage over IBM's new midrange Model 50 and 60 PS/2s. It shouldn't affect IBM, which wasn't planning to ship high volumes of '386 machines this year anyway," said Mike Orsak, a computer industry analyst.

Sigma's VGA-compatible board

Sigma Designs has joined the Video Graphics Array (VGA) derby, announcing that this month it will ship a video- graphics board that

provides VGA-equivalent high-resolution graphics to IBM PCs, XTs, ATs and compatibles and IBM Personal System/2 Model 30 machines.

Called the Sigma VGA, the graphics board will offer VGA resolutions of 320 by 200 pixels with 256 colours or 64 grey-scale shades; 640 by 480 pixels with 16 colours; and 720 by 400 pixels in a black-and-white text mode, according to Thinh Tran, president of Sigma Designs.

The board is BIOS-compatible with the IBM VGA and permits VGA applications written by Z-Soft, Graphic Software Systems, Media Cybernetics and Autodesk to run on variable-scan-rate monitors such as the NEC MultiSync and the Sony MultiScan.

"I think there'll be much more software available soon — it's just a matter of time," Mr Tran said.

"IBM worked closely with software vendors before announcing the Personal System/2 machines," he added.

A portable Macintosh in the lap of research

For a long time now, Apple Computer has been watching the development of the laptop market and looking into making a version of the Mac that would be portable.

Apple officials to date have said that the technology is not available to make a portable Mac, but company insiders say that Apple is stepping up its research in this area and it could have a portable Mac in the marketplace by March 1988.

According to these sources, Apple has been talking with Epson about its new flat-panel screen: a full 80x25 lines, high- resolution screen that resembles a gas plasma display.

Apple is also reportedly talking with Datavue and looking at making its Key-style 80 keyboard a part of this new Mac.

Apple is very aware that companies like Dyna, Colby and Intellitect are hotly pursuing the 'portable Mac' concept, and may well have machines on the market by the end of 1987.

The key here will be Apple's continued agreement to license the ROMS to outside developers as they have with Dyna.

If Apple wanted the portable Mac idea for itself, it would just have to discontinue letting these ROMS go to other developers.

But these Apple sources believe Apple will continue to license these ROMS to a select group of developers, while stepping up its own launch plans.

Because of Apple's manufacturing capability, the company could easily underprice all of the competition, and in fact control the entire portable Mac market. Although there are people who would kill for a portable Mac, the real issue in the long run will be price. Apple would have to sell this product at around the $US3495 mark, and have a pricing parity with products like the Toshiba T3100.

The laptop market is very large, and no doubt Apple will eventually play a large part in it.

In other laptop-related news: Hewlett-Packard will soon release a new 80286-based laptop. It is reportedly equipped with a new colour LCD screen that has been getting rave reviews when shown to beta test sites.

Also, IBM is reportedly working on its own 80286-based laptop. It is supposed to come out as the Personal System/2 Model 15, and be introduced by December.

Also, look for Compaq to bring out an 80286 laptop by the end of the year that looks much like the Toshiba T3100.

Tim Bajarin

A dynasty in the making?

It's been over two years since Jack Tramiel, original founder of Commodore, had a major run-in with Irving Gould, then, and still, chairman of the board of Commodore.

As the story goes, Mr Tramiel wanted to get his boys more involved in the company and asked that they be given executive positions.

At the same time, Mr Tramiel felt that he had strong board support to accomplish this, and began lobbying to move others out and replace them with his own kin.

As you imagine, Mr Gould felt that Tramiel was overstepping his bounds, and since he had more board cronies than Tramiel, he was able to fire Tramiel and force him out of the company.

There has been very bad blood between these two ever since, and various suits and countersuits have been filed against each other since Tramiel left.

Although the most interesting suit, dealing with Atari's claims of ownership of the original Amiga chips, has been settled, there is still no love between these two companies.

In the meantime, Tramiel has started his own company, and then eventually folded this venture into Atari when it was offered to him.

Mr Tramiel's success at Atari is amazing. In just over two years, he has paid off the Warner debt, the firm from whom he bought the company, and has made the company profitable.

His ST computer has been very successful, and his game computers are adding daily to the company's profits. He has taken the company public and raised an additional $US30 million in capital for expansion, and no-one in the financial community is willing to bet against this durable man and his company.

On the other hand, Commodore Computer has a debt of over $US100 million still outstanding with the banks, and although the company has been barely profitable for the last two quarters, its position is very shaky.

The key figure in the Commodore success formula has been Thomas Rattigan. This former Pepsico executive has taken the company and given it solid strategic planning and product stability. The banks liked him as well; unlike Irving Gould, known as a hard nosed businessman who can only be in his New York offices two days a week due to his US resident status. The banks are less favourable to him, and preferred the style and stature of Rattigan to Gould.

But, two months ago, Gould also felt threatened by Rattigan's continual rise in company power, and got the board to fire him. Although some new senior management has been brought in, this firing will cause Commodore to lose valuable time in its attempt to keep the company alive. Commodore's Amiga is technically a sound product, but its price and position has made it a failure to date.

While Atari has over 900 software packages for its ST, Commodore has less than half of that available for the Amiga. Add to that Commodore's attempt at the low-end PC market with models that sell well internationally, but have been a disaster in the US market.

Although the new version of its model 128 has picked up some market steam, the recent US price cut by Atari now means the entry-level version of its model 520 ST, without a monitor, will sell for $US199 (if a disk drive is bought at the same time), allowing it to go head to head with the 128. If the two machines were compared, users would no doubt opt for the ST over the 128.

A few months back, Silicon Valley rumours had it that Jack Tramiel was convinced that Commodore was about

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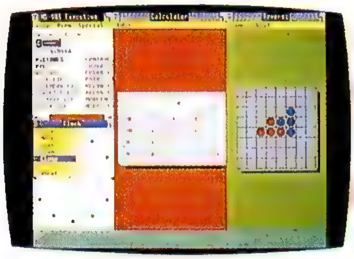
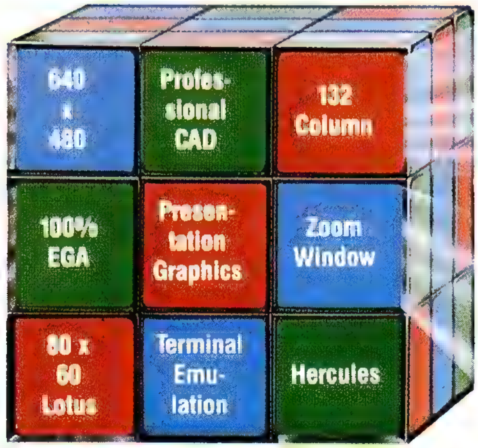
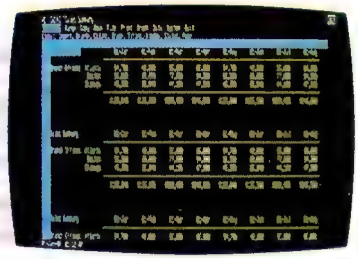
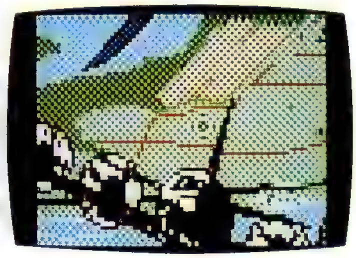

1. MS Window 640 × 480




4. 132 Column EGA

2. Guaranteed EGA Compatibility


5. Dr. Halo Zoom Window in EGA or "480" Mode

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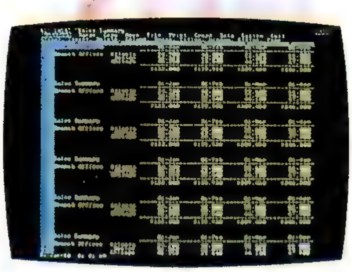
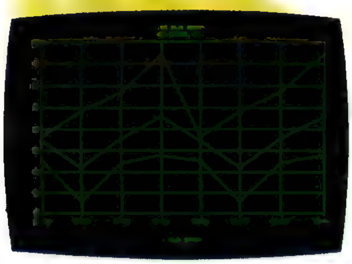

3. 80 × 60 Lotus Spreadsheet in "480" Mode


6. Hercules Compatible

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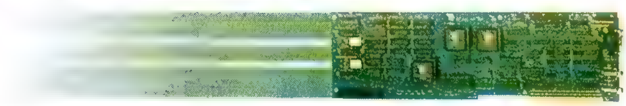

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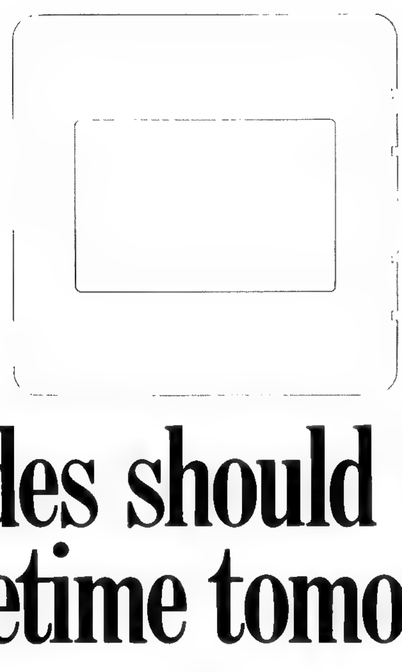

to go under, and was interested in bailing Commodore out by offering to merge the two companies into one.

Although this may be more fiction than fact, this possible new pricing by Atari, which pits the ST against Commodore's bread and butter product, the Model 128, could be the straw that breaks the camel's back. While Atari could gain important market share with this tactical move, Commodore could be left holding the bag (and its inventory).

Regardless of whether Tramiel tries to go after Commodore or not, many feel that Commodore's only salvation will be to sell out to someone who could offer the banks a solid guarantee, and give the company some capital to remain a serious player.

Since this is just mid-year and the squeeze is not quite here yet, Commodore has a chance to prove its worth and viability but it is at its most vulnerable point. It would not be too surprising to see some corporate raiders make a charge for this battered company.

Tim Bajarin

The game's on

In 1985, when the market for home computers began to dry up, so did the market for computer game machines. The pundits at that time declared those two markets dead, never to rise again.

Well, it looks like the pundits were wrong again.

The hottest market in the States today, besides business computers, is that of dedicated game machines. Companies like Nintendo and Sega are selling their computer game machines for $US125 a pop — and they are selling like hot cakes.

At the same time, game cartridges for these machines, selling at $US25 to $US35 a piece, are also hot items, and both companies are bringing out at least three new titles a month.

This market has been one of Atari's staples over the last three years, and has kept the company afloat.

Why this resurgence?

When the home computer market began to falter, the serious players like Texas Instruments, Fairchild, Atari and Commodore began shifting gear and moved away from these game machines. TI and Fairchild got out completely, while Commodore and Atari went after the more powerful markets with the Amiga and the ST. But, although a PC approach to this game market also gives the user more versatility, the bottom line is that games are more for kids than adults.

So, while parents would buy PCs for their personal use, they would find that they would have to share it with their kids — who in many cases dominated the PC usage time.

In Silicon Valley, where some 20 per cent of homes have personal computers, a survey has shown that kids are very rough on the keyboards and mice and, since the average PC costs around $US1500, many parents have started buying the kids their own game machines.

At last year's Consumer Electronics Show, there were only 11 manufacturers of home or game-type products. By comparison, this year's show, held May 30-June 2, had over 40 related vendors. As prices of these game machines come down, watch out for this market to take off.

Tim Bajarin

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BENCHTEST

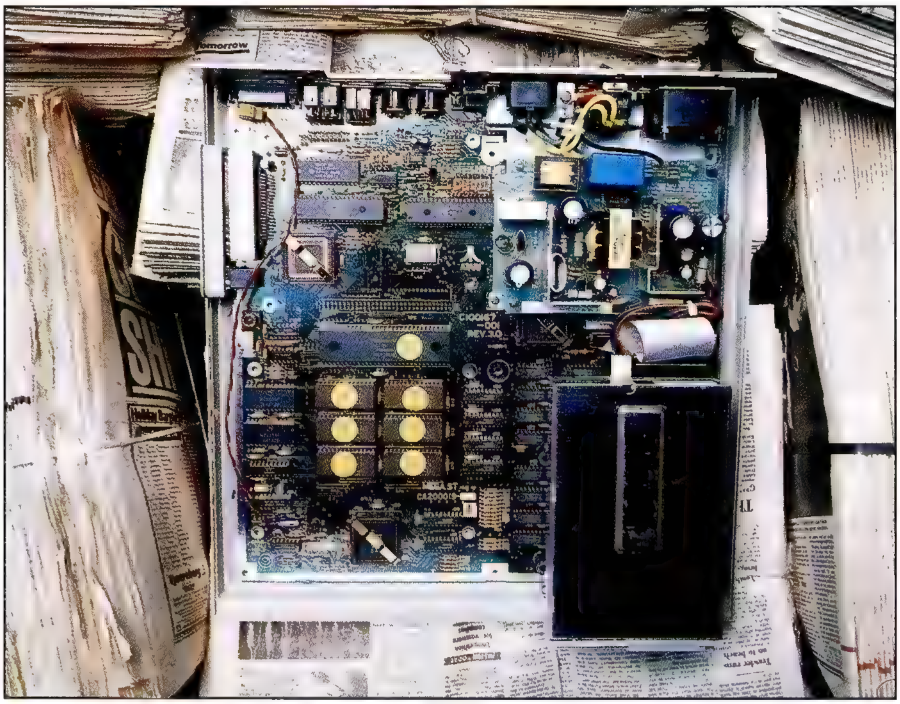
Atari DTP

Nigel Shepherd started his association with Commodore when, as an employee of Hanimex, he picked up the Australian distributorship of Commodore products. He was then invited to launch the Australian office of Commodore; and further invited to take up a senior international role with the parent company. But then it all went sour during the recent turmoil which saw the firm's CEO, Tom Rattigan, unseated along with a number of his lieutenants, Nigel Shepherd included. Nigel is now back in Australia — to head up the (soon-to-be-launched) Australian office of Commodore's arch rival, Atari. This exclusive preview is of Atari's latest, due to be launched here in September. The Benchtest is by Nick Walker on a prototype in Europe.

The Atari 1040ST was proclaimed a bargain in 1986, offering 1Mbyte of RAM for less than three thousand dollars. One year on and Atari is offering a new range of STs with twice that amount of RAM for the same price. The new Mega ST range is Atari's renewed attempt to establish the ST as a serious small-business computer, one of whose target markets is desktop publishing (DTP). Atari intends to poach potential Apple Macintosh DTP purchasers by offering an equivalent system for considerably less cost. On paper the Atari ST looks good against the Macintosh with a higher-resolution white screen monitor, two or four times more RAM and similar processing power. The success of Atari DTP packages depends on the price of Atari's laserprinter, the quality of the software offered for it and the public acceptance of the Atari name as a purveyor of business hardware.

We were privileged to take an early look at both the Atari laserprinter and the 4Mbyte Atari Mega ST4. To gain an insight into the potential of Atari DTP we also took a look at the two leading packages — Fleet Street Publisher from Mirrorsoft and Publishing Partner from Softlogik.

The Mega ST4 contains a very comprehensive collection of ports compared to the 1040ST — the only difference is the addition of a fan



For a prototype machine the Mega ST4 is very well finished. The gold-edged chip to the left is the blitter — the fifth of Atari's custom chips

Hardware

The Mega ST does seem delightfully small, even though the footprint is larger than a 1040. I'm so conditioned to an IBM PC-size box that the Mega ST seems positively minute in comparison. Not having to accommodate IBM PC-type expansion cards means that the Mega ST has a very low profile — being only six centimetres high. The 'high-tech' slanted function keys, LEDs and light grey colour scheme have been maintained on the Mega which gives it the ST family look. I must admit that when the new Atari 'tilt and swivel' monochrome monitor was mounted on the machine it did look suitably professional.

Like its predecessors the Mega ST is positively bristling with ports. Looking at the back of the machine it has the following: 25-pin RS232 serial port; parallel (Centronics) printer port; MIDI in; MIDI out; video out; external floppy disk drive port and a high-speed DMA (Direct Memory Access) port. Also to be found on the rear of the machine is a reset switch, power input, the fan outlet and an 'empty hole' with a panel over it labelled 'expansion'. On the right-hand side there is a recess that contains the cartridge port (up to 128k of ROM) and the keyboard socket. The only other external features of interest are the two joystick/mouse ports at the rear of the keyboard and the floppy disk slot on the front of the system unit. The internally-mounted fan is very noisy for its size.

The heart of the Mega ST is a Motorola 68000, true 16-bit processor (16-bit external address and data lines, 32-bit internal word size) driven at 8MHz. I was disappointed to see there is still no socket for the Motorola 68881 maths co-processor. In answer to the reader who wanted to know why I was enthusiastic about the 68000, its use of a maths co-processor is a perfect example of the Motorola's superiority over, say, the Intel range of processors. Add a maths co-processor to a Motorola system and all software makes use of it; an Intel co-processor will only work with a small proportion of the available software and then only when re-configured. Five large custom chips perform a lot of the tedious memory manipulation leaving the

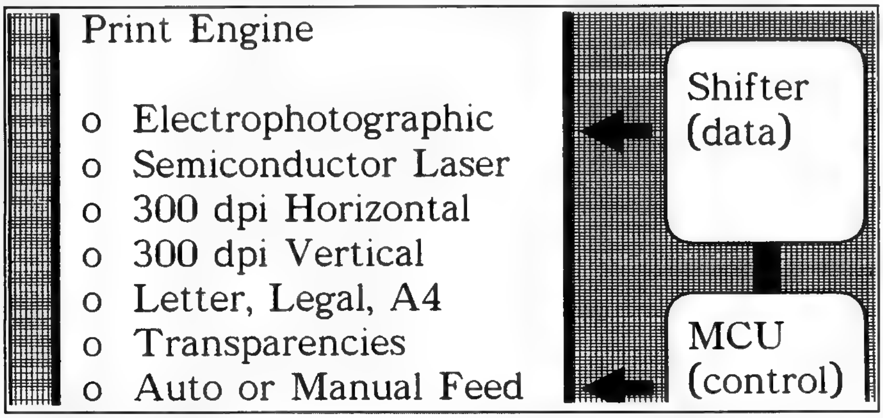
Atari laserprinter

The laserprinter supplied with the review machine was a prototype but I was assured by Atari that it was a prototype of the model the company would be selling. The engine of the Atari laserprinter is a TEC, which is a Japanese engine that has not been used in any printer other than TEC's.

For Atari the printer has been reboxed and much of the internal circuitry has been removed. It is both smaller and lighter than the majority of laserprinters, but even so it's an imposing box that dwarfs the Mega ST. Along the front there is a row of five graphic LEDs signifying: printer online and ready; printer not ready; toner low; paper jam; and paper out. Below the LEDs there is a paper tray capable of taking 150 sheets of paper up to foolscap size, but no bigger. Once printed the paper lands face down on top of the printer and so keeps the original printing order. Otherwise the printer is fairly boring to look at — there is a Centronics-type port on the back and a number of catches to get inside.

The most significant difference between the Atari laserprinter and similar products is that practically all the internal memory and processing power of the printer have been removed. The usual method of sending data to a laserprinter is in some form of code (Postscript and DDL are examples that use graphics; Epson and Diablo codes are frequently used for text only) and then the onboard processor and memory within the laserprinter will convert this into bit-image, for printing.

On the Atari system all the page definitions need to be done within the ST and sent down to the laserprinter pixel by pixel, which at a resolution of 300dpi (dots per inch) will take a lot of processing power and memory. Not surprisingly the Atari laserprinter will only work with 2Mbyte or 4Mbyte STs and even with my simple experiments it took up to 15 minutes to calculate a graphic image before printing. Atari claims an eight pages per minute output for the printer, but even a simple page comprising just one dot could only be produced at four pages per minute. The other problem that Atari has created for itself is the 1.5Mbytes of data that needs sending down a wire to the laserprinter. An ordinary Centronics printer port would be too slow so Atari sends the data down the DMA channel. Normally data sent down the DMA channel is not meant to travel more than about three feet, so Atari supplies a converter box to amplify and buffer the data. An additional problem is that switching off the laserprinter while it is connected to



A sample of the laserprinter output produced using EasyDraw 2

processor free to get on with its number-crunching. They are not named as on the Amiga but generally their functions are: bus organisation and processor support; graphics processor; blitter and DMA.

RAM on the Mega ST4 is 4Mbytes made up of 32 1Mbit DRAM chips with a refresh rate of 120ns. Previous STs were limited to a maximum of 4Mbytes, addressable RAM due to the way the hardware memory management operated. The new memory manager chip found on the Mega STs removes this limit and allows RAM to be expandable to the 68000's maximum of 16Mbytes. This new chip will be made available to existing ST owners as an upgrade. It was nice to see that the RAM chips were socketed allowing this expansion to be internal when 4Mbit RAM chips become generally available. ROM on the Mega ST totals 192k containing the BIOS (basic input/output system); ABIOS (advanced BIOS); TOS and GEM (Graphics Environment Manager from Digital Research).

Getting inside any Atari computer is not an easy job due to the excessive amount of metal shielding needed to conform to FCC radio interference regulation. Removing the outer plastic cover was easy, but then I was faced with a metal box covering the entire PCB and held with about twenty metal tags.

Carefully twisting the metal tags with pliers took half an hour, after which all I needed to do was disconnect the floppy disk drive from its mountings. Having removed the cover I soon realised why Atari makes it so difficult to get inside — to the back right of the PCB is a totally exposed mains-driven power supply capable of delivering a hefty 240 volts if still plugged in.

No-one at Atari had mentioned a real-time clock for the Mega ST, so I was surprised to find a battery carrier in the outer case and a wire leading to the PCB. I plugged in two batteries and it worked fine, although access to the battery carrier is very awkward without removing the outer cover.

In the middle of the board there is the pin-out of what on earlier machines was once a slot designed to take an expansion card. A phone call to Atari confirmed that this is still the case. Apparently someone at Atari had forgotten to solder the socket onto the review machine. At the time of writing the configuration of this slot is still undecided — it will give full access to the internal bus as well as access to other areas such as the cartridge port. Expansion cards that need to talk to the outside world can do so by removal of the plastic cover on the back of the case. Despite the incomplete specification there are already some American add-on manufacturers developing internal modems and hard disks for this socket.

The disk drive in the Mega ST is a standard 800k, 3.5in floppy taking a double-sided, double-density floppy disk.

The monitor supplied with the review machine was the 640x400 pixel 'paper-white' monochrome model. This is now packaged in a tilt and swivel casing which makes it a lot easier to position. Owners of existing 520/1040 STs will

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the DMA channel will cause the ST to crash.

The port on the back of the printer looks like a Centronics but is in fact a custom port with a different pin-out. Connecting it to an IBM-compatible as a standard Centronics proved to be a trauma which took the laserprinter half an hour to get over. Atari claims that the final model will have two ports, one for Centronics and one for Atari DMA. I couldn't find anyone at Atari who knew how much memory was left on the laserprinter's PCB but my rough calculations with pure text files suggest it is about 2k.

Laserprinter manufacturers claim there is a lot of difference in print quality between an expensive laserprinter and a cheap one. Well, all I can say is that I can't tell the difference — the print quality of this cheap Atari printer is to me as good as that of the $10,000 Apple Laserwriter. A colleague of mine who is familiar with most of the commercially available laserprinters was also unable to tell the difference.

The laserprinter looks nice but the insides are cut down to the minimum

The prototype nature of the review model meant that the page counter was disconnected, the socket was badly soldered in place and there was a true Centronics port dangling within the machine. All these problems will, I'm assured, be sorted out. However, the engine will remain the same and it is this that gives cause for concern. It is all too easy, when replacing the toner cartridge to misplace it and spill toner over the printer. Also the drum is too accessible and could be damaged by both fingers and light if the printer were left open for any length of time. The most worrying problem is that when the printer is open, pressing one of the side catches will cause the toner cartridge to fall, which could seriously damage the printer. There are a lot of warnings of this problem both on the printer and in the manual; even so, I say proceed with extreme care.

also appreciate this, as it lifts the monitor clear of the back of their machines. The screen quality is quite acceptable but not as clear or as bright as the screen of, say, an Apple Macintosh.

The keyboard on the Mega ST4 is identical to that of the Atari ST consisting of 96 keys comprising ten function keys across the top, a numeric keypad to the right, the main QWERTY section on the left and some cursor control keys between the two. For a low-cost keyboard it feels well-made and is pleasing enough to use, although I prefer a positive key click such as on IBM keyboards. A mouse comes as standard with the ST and is the only way of driving much of the available software. Atari will also sell an external Mega-style 20Mbyte hard disk.

Software

The operating system supplied with Mega ST is called TOS (Tramiel Operating System) and is in fact a version of CP/M68k. However, for the ordinary user, the only way to access this operating system is via GEM, a WIMP (window, icons, mice and pulldown menus) environment from Digital Research. The operating system is now in ROM so that switching on immediately takes you to the GEM desktop.

TOS has gone through numerous revisions with each new ST machine and is now a fairly robust operating system. For those interested in such things the changes in this latest revision include better support for the blitter chip and correction of the bugs that caused the RS232 and VT-52 emulation to crash.

Benchmarks

Intmath	1.4secs
Realmath	3.4secs
Triglog	7.6secs
Textscrn	39.9secs
Grafscrn	93.1secs
Store	55.5secs

Benchmarks carried out in STBasic. For a full explanation of the APC Benchmarks, see the November 1986 issue.

Also the new TOS has been designed to work with the memory management schemes of both the old ST and the new Megas. Rumours that the access and read times of disk drives have been improved with this version of TOS are untrue.

The only visible difference between GEM on the Mega and GEM on the earlier machines is an extra entry to the 'options' menu on the GEM desktop. This allows you to switch the blitter on and off for programs that are either incompatible with it or too fast with it switched on.

Obviously there was no application software designed to work specifically with the laserprinter. The software houses I spoke to said as soon as they were convinced that Atari had truly decided on a specification they would produce drivers for it. The picture is also complicated by the fact that Atari will be using a Ricoh engine in its laserprinter for the US market. In order

to use the printer Atari has produced a GEM GDOS driver which operates via the GEM utility 'Output'. This takes a GEM metafile and uses the full resolution of any output device available for it. I'm sure that the number of applications that will produce metafiles will increase with the advent of the laserprinter.

Prices

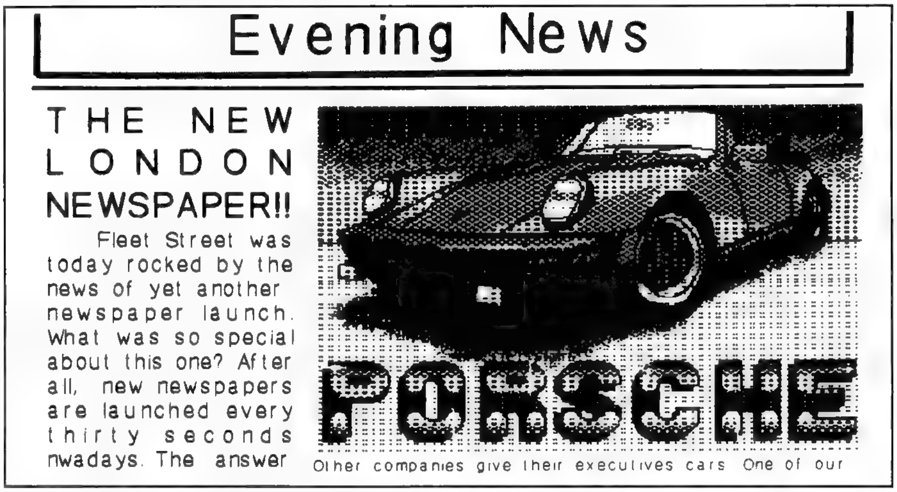
Although no official price has been agreed upon, the Mega ST2 with 2Mbytes of RAM and a monochrome monitor can be expected to sell for around $3000; a similar system with 4Mbytes of RAM will cost approximately $4000. No official price has been agreed for the laserprinter at the time of writing but it will probably cost in the region of $3000. There will be a special bundle of Mega ST2, colour screen, laserprinter and desktop publishing software available later in the year. Once again prices haven't been decided but the whole system will be less than the sum of the individual components.

Conclusion

In the two years since its launch the Atari ST has evolved into a very desirable small-business computer. The Mega ST is the most developed form of the ST design, and although the laserprinter was an early prototype and had a number of shortcomings, in its final form there will be little to distinguish it from models costing $3000 more.

Application software for the Atari ST is just beginning to fully exploit the power of the system and use the capabilities of GEM. The two packages reviewed here, Publishing Partner and Fleet Street Publisher, have their faults but neither would disgrace an Apple Mac or IBM PC. There should be no shortage of quality DTP software capable of using the laserprinter as soon as its technical specification is made available to the software houses.

The future of the system all depends on availability and price. Our feeling is that if the complete DTP system costs less than $7000, it could make a serious impact on the DTP market. It *must*, however, be made available in the very near future. The DTP market is very competitive and there is no shortage of manufacturers looking to develop systems that could push Atari out of the running.


Evening News

THE NEW LONDON NEWSPAPER!!

Fleet Street was today rocked by the news of yet another newspaper launch. What was so special about this one? After all, new newspapers are launched every thirty seconds nwadays. The answer

PORSCHE

Other companies give their executives cars. One of our

A sample of output from Publishing Partner on a 24-pin printer. Note the character and line-spacing, and how well-formed individual letters are

Publishing partner

Publishing Partner is a desktop publishing program for the Atari ST. It was designed with the ST in mind and the authors took one and a half years to research the program with typesetters and printers. The program was announced at almost exactly the same time as Fleet Street Publisher and the two programs are natural rivals. Publishing Partner has been available in the United States for a short time and has been well-received there.

Desktop Publishing on the Atari ST is a very big topic at the moment with the advent of the Atari laserprinter, and SoftLogik is obviously aiming to have Publishing Partner become the official Atari DTP package.

Given this situation, it is hardly surprising that there will be some difficulty in getting users to purchase a desktop publishing program until the Atari laserprinter is in the shops or until Atari endorses one or more products.

SoftLogik has solved this problem to some extent by providing comprehensive support for dot-matrix printers. The big problem with dot-matrix printing for desktop publishing is that the print quality is not good enough for quality output. SoftLogik has to a large extent got around this problem by driving dot-matrix printers to the very limit of their capability and producing dot/pixel densities of up to 240x216 dots per inch on 9-pin printers and 360x360 dots per inch on 24-pin printers. This last resolution is in fact better than most laserprinters, although the actual quality is still not quite as good since the dots themselves are bigger.

Publishing Partner comes on four disks, two of which are program disks: one colour and one monochrome version. There is also a disk of printer drivers and a disk holding clip art and a font editor. Other disks with more clip art and fonts are also available. The package comes in a large video-cassette-style box which also holds a paperback, spiral-bound manual.

Publishing Partner uses a fairly standard style of screen layout. Editing of pages takes place in a large window filling most of the screen. The window cannot be moved, although its size can be changed. Only one document win-

Technical specifications

Processor:	Motorola 68000 running at 8MHz
ROM:	192k
RAM:	4Mbytes expandable to 16Mbytes
Mass storage:	One 800k, 3.5in floppy disk drive
Keyboard:	96-key, full-stroke
Size:	System unit: 36cmx36cmx7cm Keyboard:47cmx19cmx3cm
Weight:	8.1kg
I/O:	RS232 serial, Centronics parallel, MIDI in, MIDI out, video out, external floppy disk, DMA fast data port, cartridge port and two 9-pin mouse/joystick ports
DOS:	TOS (version of CP/M68k) and GEM (Graphics Environment Manager)

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Transfer Rate (K bytes/sec)			125
Memory Capacity (K bytes)	Unformatted	Per Track	3.125
		Per Track	174
	Formatted	Per Track	0.128
		Per Track	2.048
		Per Track	81.92
Inside track recording Density (bpi)			2768
Inside Track Flux Density (frpi)			5536
Sectors Per Disk			17 to 21
Tracks Per Disk			36
Track density (tpi)			48
Number of heads			1
Track to Track Access time			6ms
Disk Rotational Speed (rpm)			300
Motor Starting Time			150ms

MEASUREMENT (mm): 150 × 50 × 270
5pcs/CTN/18.5Kg/2.22'

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dow can be open at a time. Above the editing window is the standard Atari ST menu bar with drop-down menus covering file, layout, view, style, format and edit options. To the right of the window is the toolbox area. This is similar to the toolbox in MacPaint in that it consists of icons in boxes, each of which enables a different range of functions.

This toolbox is split into areas of different types of function. The top area of four boxes has icons for text, objects, cutting and pictures or graphics. When each of these is clicked on, the icon reverses and changes occur in the main editing window. The two main icons are text and objects. When the text icon is clicked, all current objects are deselected and a text cursor appears in the current object. An object is a defined rectilinear area of the screen. In text mode, text can simply be typed into the program as if it were a word processor. The most important use, however, is importing text from external files previously prepared on a word processor.

When doing this, care needs to be taken that the layout for the page or document has been set up correctly. If it has not, then you will either need to spend quite a long time making fiddly changes or set up the page and reload the text. In text mode many of the options from the pulldown menus are available to change the font and typesize, or the style of the text, or justification, for example.

The object mode is used to actually lay out the document. A pointer is used to create areas for the document or finely adjust areas to position them correctly. You can then manually adjust these to leave space for pictures, cross-column rules, and so on.

Object mode can also be used to change attributes of all the text in an area at one go. The other two icons in the top area of the toolbox are the scissors icon for cropping and the picture icon for using the picture buffer.

The next area of the toolbox contains graphics icons for drawing. This allows you to draw lines, boxes, circles, ellipses and also do freehand sketching on the document. Each of these is treated as an object and can be resized and moved without affecting the rest of the document and without loss of resolution.

Below this is the master page icon. A master page is one from which layout, and so on, is copied for every page in the document. Some flexibility for left and right-hand pages is allowed, which is useful in book publishing. Finally, there are three icons at the bottom for controlling line width and style, fill patterns and colours used.


Personal Computer Evening News

THE NEW LONDON NEWSPAPER!!

Reet Street was today rocked by the news of yet another newspaper launch. What was so special about this one? After every thirty seconds nowadays. The answer, of course, is the new Scourge of the Street of Shame, Owen Underholm

For the past month Owen Underholm has been terrifying the press barons with his new tactics involving ultra-modern technology. His use of Atari ST computers and desk-top publishing has revolutionised production. It is estimated that Owen Underholm can produce a one page newspaper in only three days!

Adjustment to the same page in Publishing Partner. The character spacing is much better, but still not satisfactory

All of these toolbox functions are easy to use and reasonably intuitive. The biggest problem is the strange style of the display. Although the window is GEM-like in operation, it is different enough to make you feel uneasy — as if something is wrong. A few of the icons are also unnecessarily ugly and don't really portray their functions very well. None of this affects the function, however, and all of the functions operate quickly.

The menus across the top of the screen give access to all the other features of Publishing Partner, each of which has a large number of options — many with keystroke shortcut commands.

The 'File' menu has all the usual options to load and save documents to the end of another. Importing and exporting text or pictures can also be done from this menu as well as access to the printer.

Printing takes a considerable amount of time and cannot be done in background mode. This is because of the way that Publishing Partner stores fonts and because of its highly advanced printer drivers. Before printing, Publishing Partner has to calculate the correct bit-image to send to the printer. This can be very complicated because printer fonts are stored as collections of arcs, lines and fill patterns. The bit-image for every character in a font at different sizes thus needs to be calculated before it is printed. Any free RAM available is used for these calculations, so it proceeds more quickly on a 1040ST than on a 520ST (an average printout takes from 3-5 minutes).

The plus side of this is that each font needs to be stored only once and any point size can be accurately generated from it. This means that Publishing Partner will produce an accurate representation of a font in any point size up to its maximum of 216 point. This combined with the advanced printer drivers means that the appearance of text can be of very high quality even on limited printers, and that a wide range of typestyles and typesizes can be used within a document with no trouble. The File menu also lets you perform disk management functions and save the configuration of the program to disk.

The next menu is 'Create Layout'. This contains options to set up columns on a page as well as tab stops and guides. Other layout commands on the menu let you insert and delete pages, change the starting page and add page numbers. You can also change the measurement system between inches, centimetres and picas. The final option lets you set up text routing between columns or objects.

'View' alters the views of the page available. You can show two full pages on the screen at once, or one, or a 50 per cent reduced view, 200 per cent enlarged view, full width or any level of magnification from 15 per cent to 999 per cent. You can also have the program display rulers along the edges of the window, show a grid over the page, show column outlines, pictures and even text-routing paths.

The 'Style' menu controls text styles from normal through outline to upside down via all sorts of other otions. All of these can be used in combination. The menu also controls fonts and point sizes. Then comes 'Format' which is a catchall for the various other facilities available. You can control super and

sub-scripts from it and their spacing relative to normal characters. You can also convert marked blocks of text to upper or lower case; justify blocks as left, centred or right; switch justification between character and word; alter margins; adjust line and character spacing and control manual kerning and hyphenation. Unfortunately, automatic kerning and hyphenation are *not* available.

The final menu is 'Edit'. This lets you delete, search, replace, copy to and from a buffer and control an insert mode toggle. It is also possible to set up and save macros so that simple keystroke combinations can be made to perform often used but complex combinations of commands.

Finally, a font editor program is included with the program. Although this is a little crude in operation and very tedious and time-consuming to use, it gives the user the chance to design *real* fonts similar to those sold by companies like Adobe. However, designing and creating a font is a very complex and difficult business and professional designers take months even when using better font-design programs than this.

In use

The list of features outlined above is impressive and it is only an outline — some of the features described control a whole range of functions. Unfortunately, the operation of the program does not always live up to the promise of all these features. In particular, text layout can be very peculiar. One of my tests of the program was a simple three-column layout on A4 paper of a shortish story along with a picture and a large headline in a greyed box. Since the story was quite short and I wanted it to fill most of the page, I increased the point size and varied the fonts until the story filled most of the page. Unfortunately, this led me to further problems. The spacing between characters now varied wildly from line to line. To solve this, I adjusted the character spacing but was unable to get the text looking right. One thing that did solve the problem was to set the text range left rather than justified. However, this seemed rather backward since the program should be helping you to overcome restrictions, not creating them.

The graphics layout commands were fine, although it would be nice to see some way of importing GEM files so that object-orientated diagrams could be imported to a page. This is especially strange since the drawing tools within the program are object-orientated. However, doing such things does involve using GDOS properly and Atari hasn't really been helpful in clarifying the use of GDOS properly for software developers.

Another problem with Publishing Partner is that it does not yet support the Atari laserprinter. I called SoftLogik in the States to find out when it would be able to provide a driver and was told that it would not be writing one until the Atari laserprinter went on sale.

Documentation

The documentation that came with Publishing Partner was decent. It covered the operation of the program comprehensively and had several hints and tips on use. The manual was produced using Publishing Partner itself and an Apple Laserwriter. However, if you look carefully, you can observe the character-spacing problem even in the manual.

Conclusion

Publishing Partner is a very interesting program and ideally demonstrates the power of the Atari ST, especially in terms of printer fonts. However, it suffers from a lack of completeness and sophistication, as is common with early versions of advanced programs for relatively new machines.

The potential is there, in combination with the Atari ST and hopefully the Atari laserprinter, for a powerful desktop publishing package at a very low price. To achieve this, SoftLogik will have to put right some of the omissions and faults.

Publishing Partner especially needs automatic hyphenation, kerning and character/word adjustment. These, plus some of the advanced features on Macintosh or PC publishing programs would make it a front runner.

Fleet Street Publisher

Fleet Street Publisher has been available for some time and is an extension of Mirrorsoft's previous program, Fleet Street Editor. It, too, is regarded as a contender for the Atari desktop publishing crown. Mirrorsoft has carefully targetted the program. Since it is completely GEM-based, it also has its eyes on the potentially extremely lucrative PC clone market.

Fleet Street Publisher has taken a different approach to desktop publishing from Publishing Partner, but not radically different.

Fleet Street Publisher comes on three disks: the system disk, with the basic necessary parts of the program; a font disk; and a graphics library disk. These are included in a wallet at the back of the ring-bound manual and all fit in a slipover box cover. Although upgrades are not yet available, Mirrorsoft promises that they will be in the form of additional printer drivers, additional fonts and clip art.

Fleet Street Publisher uses a standard GEM-based screen. Despite this, the editing screen is fairly similar to that of Publishing Partner; the main difference being that more than one editing window can be open simultaneously and that the windows are standard GEM ones and can be freely moved around the screen.

On the left of the screen is a toolbox, a clipboard and a trash icon. The tool-

With Fleet Street Publisher you can:

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- Vary the baseline.
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All of these features are essential requirements for producing output with a professional look.

A sample of output from Fleet Street Publisher using a pre-release 24-pin dot-matrix driver

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box is a thin rectangular area containing several icons for different basic functions. The clipboard and trash are standard GEM icons except that they cannot be moved. Each independent window displays the title of the document.

The toolbox contains icons for picture block mode, picture edit mode and text block mode. The program starts by displaying a dialogue box showing the date and time so that these can be properly set on machines which don't have a battery-backed clock. The program then displays a standard page with a program in text input mode.

Along the top of the screen is a set of standard GEM menus giving access to a wide range of controls for the program. To start up a new document you choose 'New Page' from the Options menu. A dialogue box pops up for you to name the new document and is immediately followed by another to control the layout of this page. This allows you to choose from standard paper sizes with A4 the default. You can also set up any non-standard size, alter margins and choose the number of columns and the gutter size (a gutter is the technical printing term for the distance between columns. Technical printing terms appear everywhere in the program. Fortunately, the manual explains them clearly).

When a dialogue box has been completed, your page appears and you are ready to start work. The toolbox functions operate in a similar way to those in Publishing Partner. Text and graphics boxes set up areas for text and graphics while text input puts you into a word processor type text entry mode very similar to that in Publishing Partner, with all the usual functions. Graphics input, however, is very different. The only drawing tool available is a simple one-pixel 'paintbrush'. This is really completely unsuitable for any graphics work and can only be used for very minor touch-ups. The box rule mode allows you to draw lines and boxes in a wide range of sizes and styles and treats them as objects so that they can easily be resized and moved.

The feel of the functions and tools is very much as expected. The only minor difficulty I had was in 'picking up' very small objects with the mouse. Otherwise, the program has the best operation and feel of any program I have come across for the Atari ST. It is one of the very few programs for the Atari which has the classy feel of an Apple Macintosh program.

Fleet Street Publisher, in common with Publishing Partner, has a wide range of commands. Most of these are accessed from the drop-down menus. The menu headings are: 'File', 'Option', 'Topography' and 'Layout'. The 'File' menu controls file operations, text import and merging, picture import and merging, access to keyboard macros, output and help files.

The 'Output' option brings up a dialogue box which is used to select the device to which output is directed. At present, the program only supports FX80 printers fully and other 9-pin dot-matrix printers to a lesser extent. Output can also be directed to GEM bit-image files but not object-orientated GEM files. New printer drivers are being written and at present a 24-pin dot-matrix driver is near completion. Drivers for laserprinters and Postscript-driven Linotron typesetting machines are also said to be on the way.

The 'Help' option loads in one of a list of prepared files giving hints and tips on certain areas of the program. Each of these is a properly laid-out page rather than simply a text file.

> *'What is a disaster is the lack of printer drivers. . . it cannot gain wide market acceptance.'*

'Option' performs a variety of functions: the magnification at which a page can be viewed can be adjusted, but not as flexibly as in Publishing Partner; rulers given in cms, inches or picas can be displayed; text can be searched for a given string, full text pages can be set up for text editing and new document pages can be set up; various text attributes and document attributes can be assigned to be preserved or changed when text blocks are moved or function key macros used; the program can be set to continually display information about the document at the cursor position; and, finally, printer controls can be set.

The 'Typography' menu controls a very impressive range of layout functions. The first option controls typefaces, sizes and 'leading above and below the base'. This last option refers to relative positioning of lines. The 'Spacing' option covers character spacing — an area where Fleet Street Publisher is far superior to Publishing Partner. A dialogue box controls changes in continuous spacing and in minimum and maximum character spacing allowed. Another option covers indents for paragraphs, hanging indents, and so on. There is also an option for one shot commands for special cases.

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Bill Beret Returns After Fraud Scandal

By Otto Blunt

Legendary pop star and self-ordained Bhuddist monk Bill Beret returned to Britain yesterday from a long vacation that took him all over the world. But the holiday also saw him fall into very deep trouble when he was arrested on fraud charges in South America.

Bill now returns to his bachelor mansion in fashionable Peckham.

More pictures Page 4

Owen Linderholm starts new London paper!

In a bold move today, a new newspaper was launched on the

Output from Fleet Street Publisher on a 9-pin printer in a condensed mode, which is the only way to produce solid black lettering on this printer

Automatic hyphenation is available and, although not perfect, is certainly adequate. The other commands available are for justification, upper/lowercase conversion, tabulation, colour, underlining and small-sized capitals.

The final menu controls overall layout and is used to change the size and position of all the different text, picture and box rule objects. The other options control what page aids are visible; the overall page layout and text linked between columns.

In use

Fleet Street Publisher is obviously not designed for large documents. Each page is stored separately, although double page spreads are more easily and sensibly stored as double-sized single pages. This means that multiple page documents are stored as several files. Obviously documents with a large number of pages shouldn't really be laid out with the program.

However, as a program to lay out small documents up to small newsletter size, it is very good. The only major failing at the moment is the very limited range of output printers. Another serious problem is with the sizes of fonts. Fonts are stored separately for a range of different sizes and intermediate values are generated from these. This results in ragged and unprofessional looking letters.

I found the program extremely easy to use and exceptionally easy to learn. A great deal of the credit for this must go to the manual which is excellent. However, I quickly became frustrated at not really being able to print out high quality output.

My test file of an A4 page with three columns, picture and headline was extremely easy to prepare and lay out. Especially impressive was the way the program handled details of the text layout. The text always looked carefully spaced and easy to read. The automatic hyphenation was acceptable and the screen lettering as well as the printer output easy to read. Fleet Street Publisher does not support automatic kerning, a facility which would be especially useful for headlines. Graphics layout was more difficult and rather fiddly. The graphics commands were certainly worse than Publishing Partner's, although they did the job — just. The Atari laserprinter is not yet supported, nor indeed is any laserprinter. This is a serious flaw.

Documentation

I wish all computer documentation was like this. The manual is clear and easy to read. The level of information provided goes up on a steady curve as you go through the manual. A section is devoted to a sample session to produce a reasonably complicated page; then the full range of commands is explained in detail. Finally, there is a large and very useful section of tips and ideas for using the program for real projects. The manual itself is typset, reflecting the inability of the program to interface with laserprinters or typesetting machines as yet.

Conclusion

Fleet Street Publisher is aimed at a somewhat lower level than Publishing Partner. Because of this, the lack of features such as automatic kerning is not a disaster.

What is a disaster, however, is the lack of printer drivers. Until the program can easily be installed for, and used with, a wide range of printers it cannot gain wide market acceptance. Nevertheless, at the lower end of the desktop publishing market there isn't a program that can beat this one in operation.

END

Fleet Street Publisher costs $399.95 and is distributed by ISD on (03) 222 2288. Publishing Partner costs $245 and is available from Mobex on (02) 406 6277.

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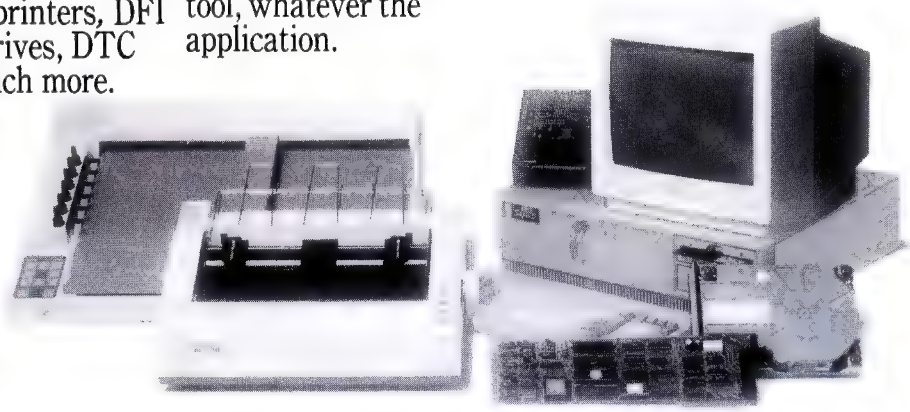

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OS/2's delay

Peter Norton writes from the US on what he sees will be big delays in the launch of OS/2.

Ever since I boldly proclaimed IBM's imminent announcement of an optical disk drive — months and months and months before the fact — I have assiduously refrained from passing along interesting bits of industry gossip, no matter how juicy they might be. This particular titbit, however, is too important to ignore.

The hot gossip is that IBM and Microsoft haven't a prayer of getting OS/2 out the door by the first quarter of 1988 — the fourth quarter appears closer to the mark.

There are several plausible explanations why the Dynamic Duo's announced schedule bears so little relationship to what the real schedule will probably be. Those of a Machiavellian nature might conclude that IBM and Microsoft know even before that optimistic schedule was announced that it would be impossible to meet. Viewed in this light, the announcement was simply the bait designed to hook some big customers that might otherwise get away. Once safely hooked, they can be left flailing until such time as it safe and convenient to haul them into the OS/2 net.

An appealing scenario in some ways, but without gainsaying the grains of truth in it, I think the real culprit lies elsewhere.

Simply put, OS/2 is turning out to be far more difficult to do, and to do right, than either IBM or Microsoft had imagined or was willing to admit.

The principle problem is the 80286: the chip perpetuates the worst problems of the 8086 series, adds some imaginative flaws of its own and tops it all off with an increased level of complexity that offers the programmer little in return.

Since you're probably aware of most of the problems inherent in the 8086 that managed to find their way into the 80286 — the 64k maximum memory-segment size being the worst — I won't go into the technical details of the problem yet again. Suffice to say that as a result, OS/2 for the 80286 needs to perform a constant juggling act, keeping four balls in the air with only two hands. That trick requires not only more time for Microsoft to set up properly, it also requires that more of the machine's resources be dedicated to the operating system.

Worth the bother?

Despite the technical problems, OS/2 for the '286 is possible — although it's questionable whether bothering with it was wise. Therein lies the second problem: a difficult technical problem is being compounded by a complex political situation. To Microsoft, OS/2 is the operating system that will make possible such exciting applications as CD ROM databases, expert systems and intelligent programs that adapt to the way a user works, rather than the other way around. To IBM, OS/2 is the glue that will bind microcomputer users to its mainframes, thereby selling more mainframe time. It is that difference in objective, I believe, that is the real culprit behind the delays in getting OS/2 to market.

The bottom line is probably that, for Microsoft's perspective (and from the perspective of any PC user with no intention of connecting to a mainframe), OS/2 is simply a bad idea. It wastes too many resources — both the programmer's and the machine's — and offers too little in return. From Microsoft's perspective, a better solution to the problems posed by OS/2 would have been to skip it and go directly to OS/3, a multitasking operating system for the 80386. Had Microsoft put the same amount of time into developing OS/3 as it has into OS/2, OS/3 would have been out months (dare I say years) ago. And it would have provided all the capabilities that OS/2 will supply begrudgingly or not at all. Among these are the ability to run existing 8086 applications in multitasking mode while maintaining interprocess (ie, interprogram) protection, access to gobs of memory and minimal demands on system resources.

Skipping OS/2 would not have been in IBM's interest, however. Big Blue needs a line of machines that spans the entire performance spectrum if it truly wants to lock up big business. OS/2 is a middle-of-the-line operating system for middle-of-the-line machines. If that's not quite what you want, just wait till OS/3 comes out: then you'll see some really exciting thingshappening.

END

Peter Norton devotes full time to personal computers and to writing books and columns. He is also the author of The Norton Utilities file-recovery programs.

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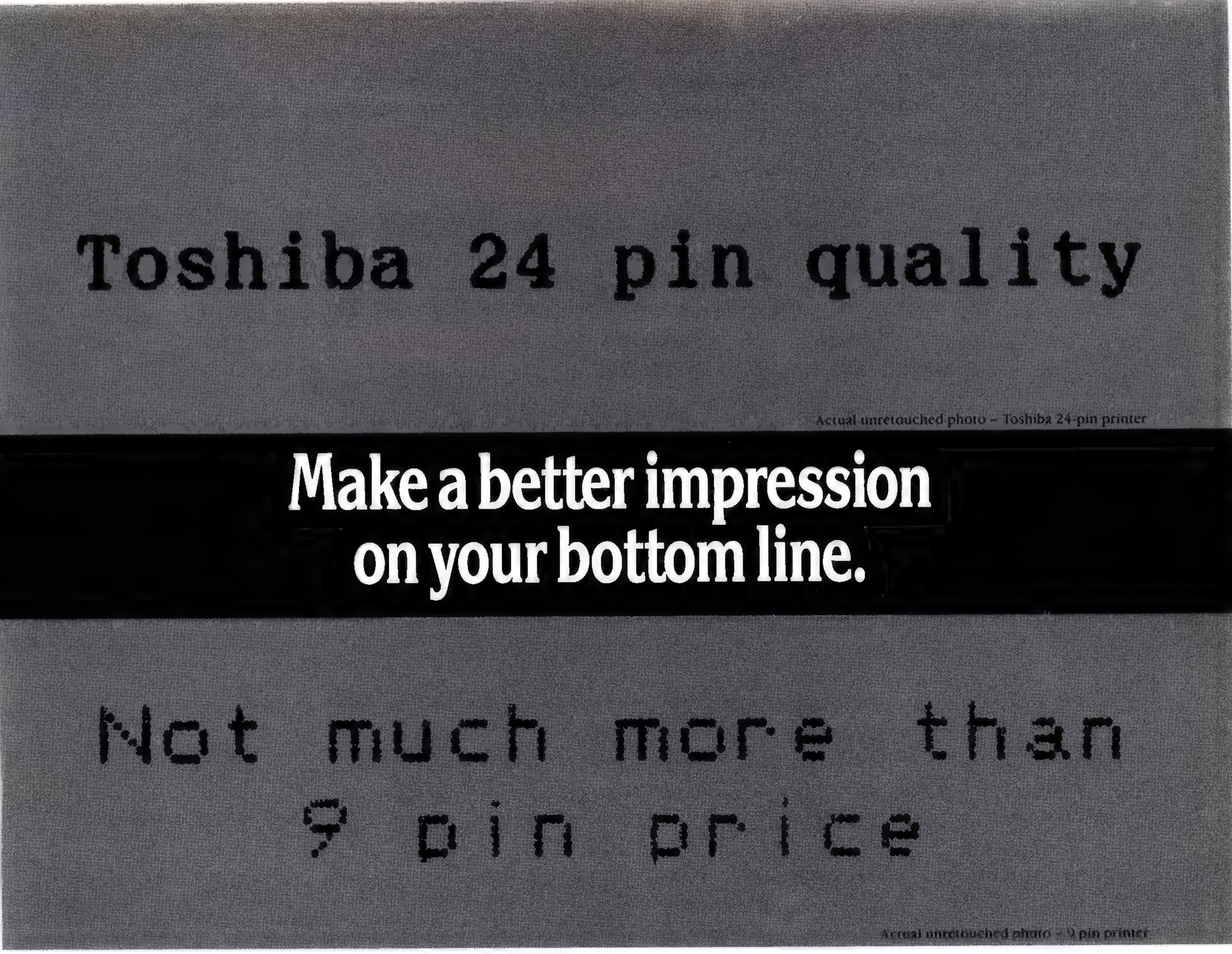

Many companies have opted for a 9-pin printer because of the cost savings. And regretted the quality of the print ever since.

If you want to make the best possible impression, it makes sense to talk to the people who know most about printers (after all, Toshiba were the inventors of 24-pin technology).

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Netcomm Trailblazer

Data communications as a part of everyday business is here to stay. This high speed DAMQAM modem from NetComm offers more than just high speed. Ian Davies takes a look.

The Trailblazer is a modem with a difference. Not only does it provide extremely high throughput over voice grade lines, but it is also designed according to a radical, and far more sensible, philosophy.

Normal modems provide a constant data transmission rate, whether it be 1200bps, 300bps, 2400bps, or a range of speeds implemented in a single box. Once a speed has been selected, data is pumped down the line at that rate. On a good quality line, the data will flow out of the modem at the other end in perfect condition and at the same constant rate. Over lower quality connections, the data rate remains constant, but the error rate increases.

For 'dumb' protocols, such as Viatel or dialing up asynchronous hosts such as a VAX, Cyber, or interactive BBSs, a low quality line will mean many transmission errors in both directions. The user must visually detect these and either backspace and correct them, or redisplay the corrupted information.

Smarter protocols, such as Xmodem, Kermit, SDLC and a multitude of others assemble chunks of data into packets and attach checksums. Using the checks and a system of timeouts, two intelligent devices can arrange for error-free data transmission even over marginal lines. Many of these protocols are too simple minded, requiring an acknowledgment of the previous packet before transmitting the next, resulting in a less than satisfactory utilisation of the line. Moreover, managing these protocols places a serious burden on both systems. As line quality degrades, the chances of a packet being hit by an error increase and the systems may spend a significant amount of time retransmitting. A small packet size results in an inefficient data to overhead ratio. In any case, often the option of an error-free protocol may not be available, such as when dialling up for interactive use of a VAX.

So, rather than opt for the conventional and unwieldy approach of constant speed with variable errors, the NetComm Trailblazer takes the approach of zero errors at a variable bit rate. And it is here that the story begins.

Method

In a word, the Trailblazer achieves this feat through the use of PEP/DAMQAM, or Packetised Ensemble Protocol Dynamically Adaptive Multicarrier Quadrature Amplitude Modulation.

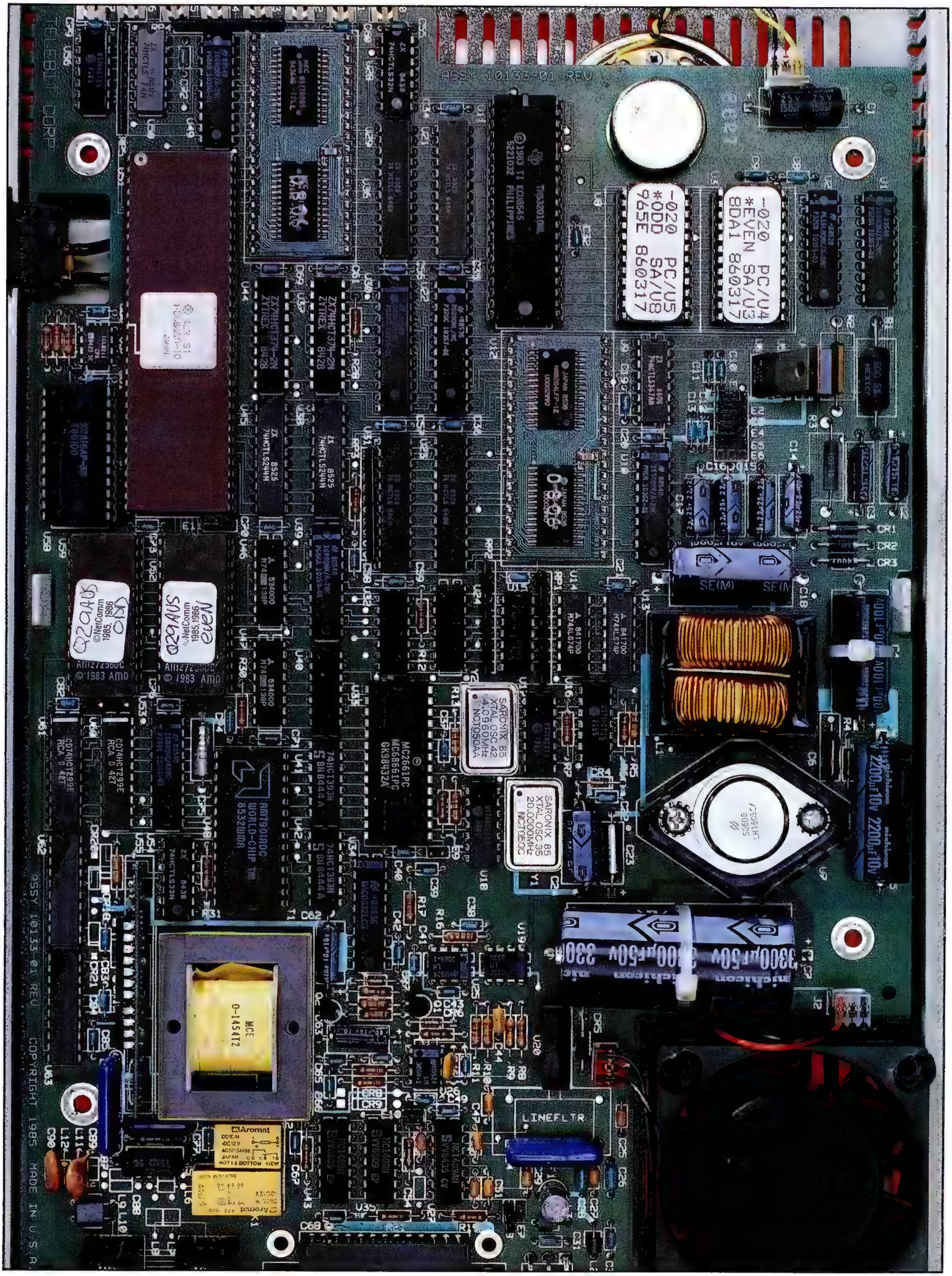
All modems use a variety of frequencies. Even a humble 300bps unit utilises four frequencies. The Trailblazer, overachiever that it is, considers a telephone line to be 512 discrete frequency channels, ranging from 0 to 4000Hz at 7.8Hz intervals.

When a connection is first established, the two Trailblazers spend a few seconds measuring the signal to noise ratio on each of the 512 channels. As Telecom equipment varies and routing may vary, the profile constructed from these measurements will probably be different even for two consecutive calls between the same numbers.

The modems then make a decision as to how effectively each channel may be used and the modulation technique independently selected between zero and six bits per channel. By knowing which frequencies are to be avoided, the Trailblazer can greatly minimise the frequency of errors while maintaining good overall throughput.

Furthermore, the Trailblazer features a built-in PAD (Packet Assembler/Disassembler) which allows normal ASCII data presented to its RS-232C input to be packetised and accompanied by a 16-bit CRC (cyclic redundancy checksum). Using this, relatively minor errors can be corrected by the receiving modem before unpacketising the data and passing it through to the DTE. Major errors are detected and the sending modem is requested to transmit.

Thus the Trailblazers approach to error-free transmission is twofold: mini-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LINEFLTR

mise the likelihood of an error through line 'training', and detect and correct errors when they occur, all without any involvement from the host or DTE.

As the call proceeds, both modems maintain a history of how many errors occurred and which channels were involved. If the error rate becomes unacceptably high and throughput seriously affected by retransmission, the two Trailblazers may decide to remeasure the line, building a new channel profile. This process takes only a couple of seconds and is completely transparent to the DTE and any data which may be in transit.

The PEP protocol is more comprehensive than most used for PC file transfers, in that it does not require acknowledgment before sending the next packet. The Trailblazer maintains a sliding window of up to twelve packets, timing out on lost packets and ensuring that all data is presented to the DTE in the correct sequence. This ability dramatically enhances throughput, as it means that the line is almost constantly fully utilised.

To cater for both keystroke-by-keystroke interactive data streams and more continuous data streams such as file transfers or host responses, the Trailblazer employs two packet sizes. Choice of packet size is made based on the number of characters in its buffer prior to packet transmission. Unlike normal packet schemes, where the packet size is measured in bits or bytes, the Trailblazer's packet size is expressed in time, 26ms and 136ms to be precise. Thus the length of a packet (in time) is constant, but its capacity (in bits) will vary with the throughput being achieved at that point in time. This is consistent with the Blazer's approach to data comms, as the probability of line noise obscuring a packet is a function of how long the packet is on the line, not how much information it conveys. Using fixed duration packets means that the Trailblazer always achieves the optimum balance of line utilisation versus probability of error.

Monitoring the line is very instructive when evaluating the Trailblazer. Unlike normal modems which maintain a constant tone when the line is idle, two Trailblazers persist in constant chatter even when no data has been presented for transmission. When the line quality varies significantly during a call, one modem will suddenly call 'time-out' and the line will be filled with a cacophony of retraining for a couple of seconds, after which the call will proceed as normal.

The end result is an effective through-

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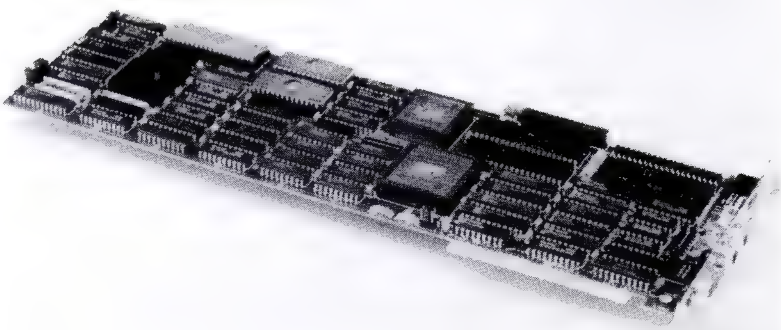

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(Time in seconds)
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CHECKOUT

put of around 18kbps on local calls, 12 to 15kbps on interstate calls and 8 to 10kbps for international links. Even at these rates, a single bit in error may be expected only once every seven years.

Features

In addition to 18,000bps DAMQAM which may only be used to communicate with other Trailblazers, the unit is also capable of V22, Bell 212A (1200bps), V22bis (2400bps) and Bell 103 (300bps). No CCITT V21 or V23 modes are provided, and the omission is probably not a serious one, as 300 baud is just about dead and your average user probably isn't going to buy a Trailblazer for Viatel access.

The modem features all the usual indicator lights including off hook, CTS, DTR and two special LEDs to indicate whether DAMQAM mode is being used.

Modem control is achieved via a superset of Hayes compatible commands. In addition to all the normal commands, the Trailblazer provides an internal dialling directory and the ability to force a line retraining sequence. During a call, modem registers may be interrogated to ascertain the current effective transmit and receive throughput in bits per second. Clearly the transmission rate in each direction may vary as the connection provided may impose different amounts of noise in each direction. The ability to obtain these statistics is invaluable, as your application software could be enhanced to query these figures after call establishment and redial if the line quality is not up to par. Even for non DAMQAM connections, the Trailblazer is able to provide a percentage which represents line quality and hence the probable number of errors.

At any time, the modem is also able to report on the total number of packets transmitted and the number of retransmissions. These statistics reflect an entire call and could be captured at the end of a session to judge the effectiveness of the modems error prevention.

Most impressive of all, however, is the line noise profile. Interrogating this register returns the 512 signal to noise ratios of the line in dBm accurate to the nearest tenth. Rumour has it that at least one company heavily involved in data communications has used Trailblazers to obtain sufficient ammunition to approach Telecom about consistently low quality lines.

Another register indicates the frequency offset of the line to the nearest sixteenth Hertz.

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that, making a total cost of $758. Now ISD has edited out over $450 of that cost by including a laser-printer option with letter-quality text of up to 300 dots per square inch.

Publisher

And the price is only $299. That's well below the price of the Apple Pagemaker, yet Fleet Street Editor still has all the features you'd expect.

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Selection of communications software raises some interesting issues. For a start, the software must be capable of up to 19.2kbps. Most significantly, however, file transfer software should not impose its own error detection protocol. Using the Trailblazer with Xmodem software, for example, dramatically compromises throughput since Xmodem will not transmit a block until the previous acknowledgment has been returned. Overlaying an inefficient block protocol on top of an efficient one is, of course, a criminal waste of time, effort and line capacity. Instead, the comms software should just have faith in the Trailblazer and assume a zero-error connection with the other PC.

A special version of CrossTalk called CrossTalk-Fast is available for use with the Trailblazer. This version supports the higher bit rates and has an optimised file transfer facility which suppresses software generated block acknowledgments when working through a Trailblazer. The latest version of the popular Carbon Copy remote access software also supports the Trailblazer.

The modem is supplied with the NetComm program, a communications package which is vaguely reminiscent of CrossTalk, but quite different. The software isn't too bad, but certainly doesn't compare to the real thing. It is less than full featured, and a little slow at times. Anyone considering serious data communications would probably want to purchase a standalone communications package.

In use

Once configured, the Trailblazer is much like any other Hayes compatible smart modem. The configuration, however, is a little more involved than most. The demo version of XTalk was provided with sample script files customised for the Trailblazer, but CC was delivered with an empty modem configuration file and presented no end of problems. Of course, configuration of communications hardware and software is never a pleasurable experience, but only has to be performed once.

Once a connection was established, true to its word, not a single erroneous character was received even on the most marginal of lines. Interrogation of the modem registers showed that line errors were occurring, but being corrected before being passed on to the PC. By turning on the line monitor, retraining on very poor quality lines could be heard and was achieved without any significant interruption to service. Most noticeable, however, was

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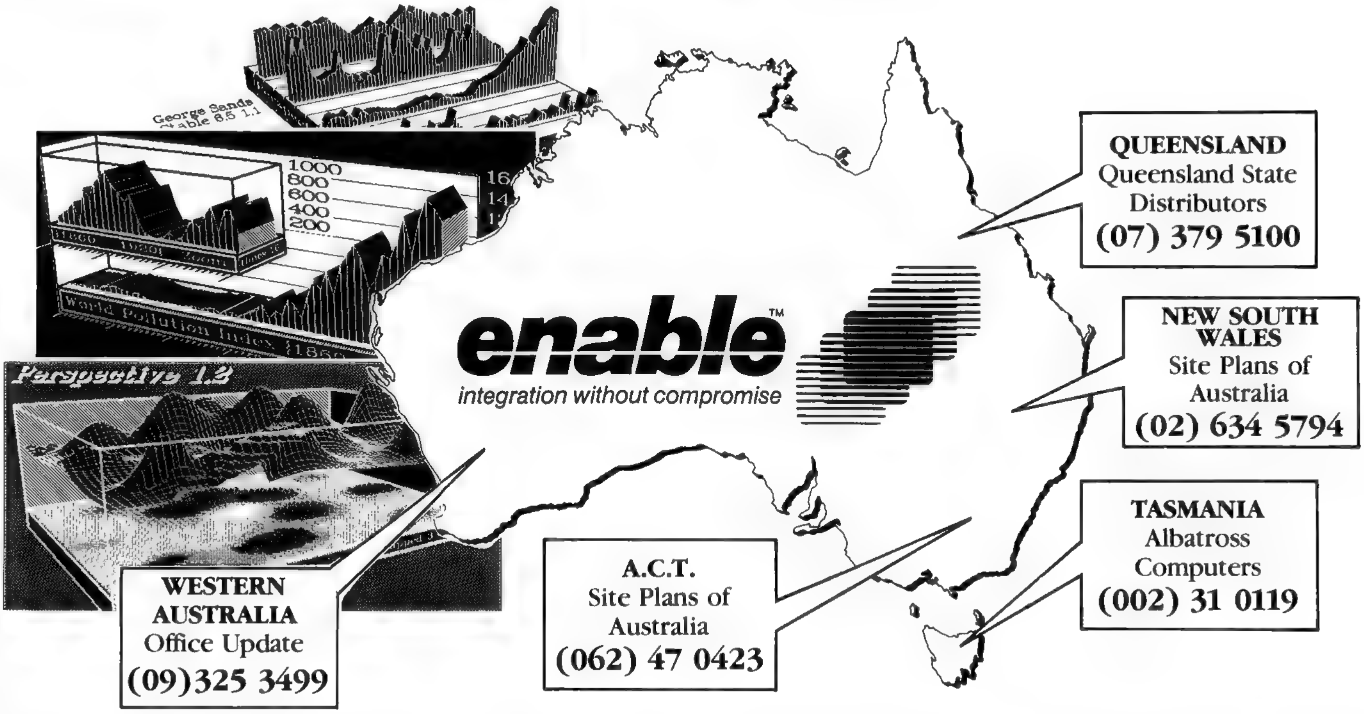

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puts varying between 12,994bps and 15,768bps, usually with a small variation between the transmit and receive rates. One extremely poor line was found with a high degree of cross-talk to another line (hello, Mavis, do you hear some funny whistling?). Even on this extremely poor line, the Trailblazer could transmit at 13,651 bps and receive at 8,176bps. In a real application, a line of that quality would normally be dropped and a redial performed.

A series of local calls were also made within the same exchange. The Trailblazer found these lines of sufficient quality to run 18,031 bps in each direction. Calls from one exchange district to another may not achieve such high data rates, but 14 to 15kbps would be readily achievable.

Table 1 summarises the results of the measurements made. The extremely fast local call recorded a data transmission time of 24.4 seconds, yet it took CrossTalk an additional 5.8 seconds to finish digesting the data and declare the file transfer to be complete. By way of comparison, a file transfer measurement using traditional 1200bps modems is also included.

	Trailblazer	1200bps modem
Cost	$2,990	$600
Monthly lease	$74.75	$15.00
Bytes/min	69000	5520
Cents/kbyte	0.6957c	8.6957c
kbytes/month	**Total cost**	
	Trailblazer	**1200bps modem**
1	$74.76	$15.09
100	75.45	23.70
747	79.95	79.96
1000	81.71	101.96

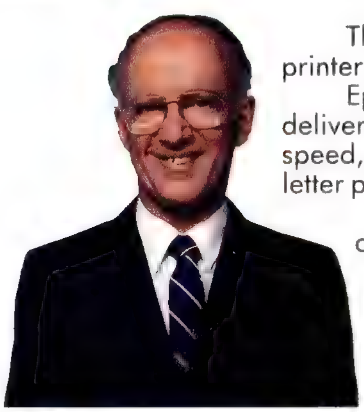
Table 2 Comparative costs of Trailblazer versus 1200bps modem

Cost effectiveness

A modem like this must cost a small fortune, right ? Wrong. $2,990 excluding sales tax for the external version, or $2,795 for the Blazer on a card. It's really quite a bargain. If one considers that a good 1200bps modem costs around $600, then the Trailblazer delivers between 10 and 15 times the performance for 5 times the price.

But as most Trailblazer uses are involved in long haul data communications, one must also consider the savings on the telephone bill.

If we assume lease costs of $25 per $1000 per month and data transfer between Melbourne and Sydney at 48 cents per minute during business hours, then Table 2 shows that the breakeven point is around 747k per month. This is assuming 93 bytes per



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second throughput for a conventional 1200bps modem and 1150 bytes per-second for the Trailblazer, although the Blazer may achieve better than this.

Communications over longer distances, such as Melbourne to Brisbane or internationally, will breakeven at even lower volumes. These figures are only relevant for mass data transfer or bulk electronic mail. For applications which involve lengthy operator think times, the raw bit rate may not be as significant. The real question is how much of the time are you waiting for the remote system to respond. If the answer is "most of the time", the higher bit rates should certainly reduce connect time.

Certainly anyone communicating more than one megabyte per month (that's about 50k per working day) should consider a high speed modem, particularly when you take into account the additional savings in people's time.

Conclusion

This is not your average modem. Its design starts with the premise that a reliable zero-error data link with variable throughput is more useful than a constant speed link with errors. The premise is correct. Data is transmitted for a reason: people want it to get there. Getting something else there instead is less than useful, and the fun and games which software can play to compensate are often less than adequate, and often not available.

NetComm acknowledges that the Trailblazer is more than a modem, requiring its dealers to attend a two or three day training course. The communications industry needs something like this, and Telebit has proposed its DAMQAM protocol to CCITT for ratification as an impaired line standard. Since all telephone lines are impaired to some extent (until ISDN arrives), it would be great to see this sort of approach universally accepted. Hopefully things will move in this direction as the market penetration improves. NetComm is helping it along, having recently reduced the price from its original $5400.

There can be no doubt of the value for money the Trailblazer offers, nor its performance. The only question is whether your organisation moves enough data around to warrant the cost, or whether you need error-free interactive communications to a host which does not offer software packetising.

END

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OK Word Processor

OK word processor from Australian Company, Pricom, is a word processor with a difference. It has all the features you could ever need — and want. Kester Cranswick tests it out.

When Fred Daly, that aged patriarch of the Labor party, wanted to write his political memoirs, he decided to use a personal computer. Though he could have chosen almost any word processor in the world for his task he chose something which most of us have never heard of. The word processor was called OK4, and it is, suprise, suprise, an Australian product. But he didn't choose it just because he saw the 'True Blue' ads on TV. He chose it because it is a bloody good product.

It doesn't sound special. OK4 costs $612 and takes up a mere 62k of RAM. The package comprises two disks and a 74-page manual. But, OK4 allows you to use 24 different keyboards of characters, with an optional 40 additional character sets. It contains a DOS variant that can be used from within the program. It has help files, automatic file saving, mathematical functions, macros, built-in communications facilities and background printing. It can deal with files up to 60k, and have up to 63 files open at once. It has a spelling checker which beeps when you type a wrong word, or suggests correct spelling, and a mail-merge feature. Finally, it is lightning fast. In short, OK4 is one of those products which impresses even hardened reviewers.

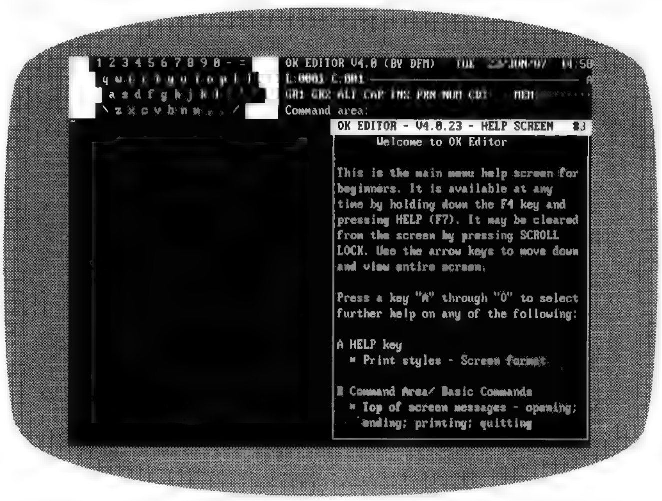
> *'Another feature is the automatic saving of files to disk after a pre-set time to obviate disasters caused by failing to save regularly.'*

It comes from a Sydney-based company called Pricom. The company is five years old, and started corporate life as an NEC dealer.

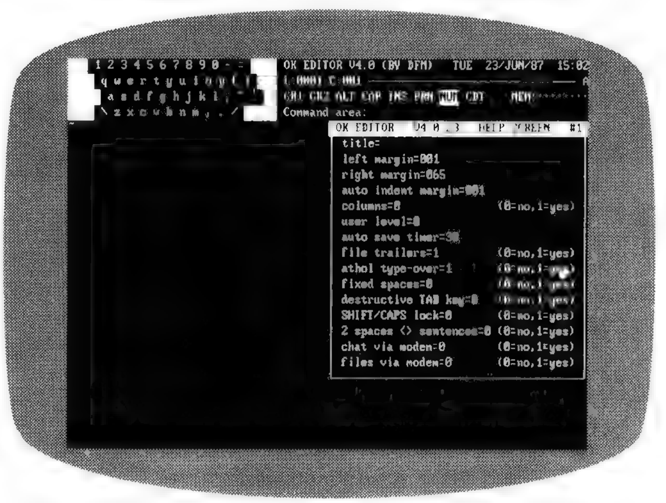
From there, the company started to write software for the original NEC APC. Its first word processor, on 8in disks, was called OK1. OK2 was an MS-DOS version of the same program. With the release of the IBM non-compatible APC III, OK3 was released. With OK4, Pricom is back to the MS-DOS world with a vengeance.

The program runs on all PCs and compatibles, as well as the APC III. Around 1000 of the previous versions have been sold, with about one-third going to discerning buyers in the US, where they are used mainly by scientific bods.

In fact, that's the genesis of the present program. It started life as a graphics orientated word processor. It was, and still is, written in a mixture of



The opening screen of OK4 following initialisation



Screen format menu showing multitude of options

C and Assembler, by a physicist called David Moody. It has deliberately not been targeted against mainstream word processing packages such as Multimate and WordStar, though it is good enough to take them on.

Installation

Of the two disks, both colourful Centech products, one contains a demo program that is more useful to dealers than users.

The second disk contains the 64 files that make up OK4 and its associated programs. You must have CONFIG.SYS and ANSI.SYS on your boot disk. To install, type INSTALOK at the system prompt. On screen prompts ask for the target disk drive (A through F), which of the 20 printer drivers you wish to use, including four laser printers, mono or colour display (choose colour for an Olivetti monochrome display) and whether you have an EGA card or not.

A couple of minutes later, the directory and .BAT files are created, and the supplied disk goes back in the box.

The only quirk to OK4 is that a file called LUNIVERS.EXE must be run before the application can be loaded. Its purpose is to load the 1200 characters available within OK4. Once run, and it can be part of the AUTOEXEC.BAT file, you can exit and restart the program as often as you like.

Once that is done, type OKE and the program loads in about two seconds, with a help screen displayed if it has been specified in the .BAT file. Position the blue keyboard overlay at the top of your keyboard, open the manual, and you're ready to go.

OK4 uses the function keys in a rather unusual way. F1, F2 and F3 are used in conjunction with the numeric keys to provide 36 functions, denoted on the keyboard overlay. F4 is given the role of a function key, and an alphanumeric key pressed with it gives more functions.

Press F5 and a status window appears. This describes each of the open file areas, by file name, size, whether it has been modified, is being sent, received or printed. It is an easy way to keep check on where multiple file activity is at, or to change from one file to another. Within this display, pressing Q when a file name is selected quits from that file, P queues it for printing, and X makes the selected file the active file. Shift and F5 display the status of files being sent by modem or being printed.

F6, when pressed, displays all files on the current disk, with their DOS names. Directories can be changed, or file names, with wildcards specified to limit the number of files displayed. There is even the option not to display specified files. The window has a flashing frame if there are files above or below its borders. But, you can do more than just view file names.

Pressing '?' when the cursor is next to the DOS file name and an OK4 filename, (up to 30 characters), is displayed. Pressing the space bar when the file name is selected opens the file. Keying 'S' sets the file to be sent by modem when data communications are established. 'P' is used to select files for printing. It is a very useful window, and indicates the power of OK4. For all these windows, Scroll Lock makes them disappear.

Help is accessed by pressing F4 and F7 together. The printer is started with a push of F8, while F9 and F10 bring alternate character sets into play.

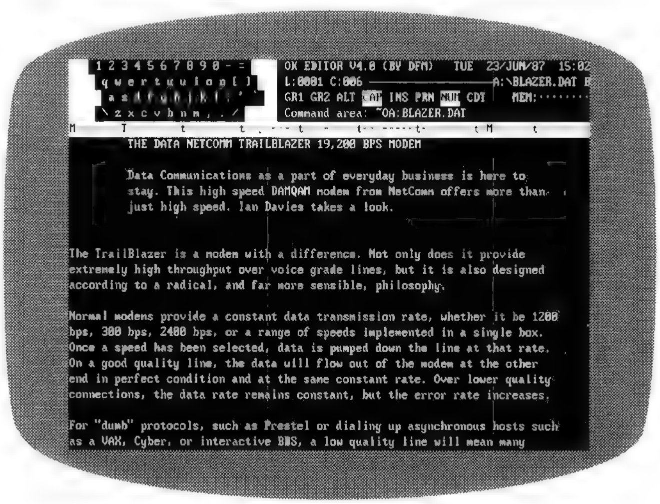
Though file names have the usual eight characters, and three character extension format, OK4 allows you to specify a more detailed file name of up to 30 characters. This is saved with the file, and can be displayed at any time.

To title a file, bring up the screen format menu by pressing F7 and type in the name. This window also lets you set the way a document appears on screen, and will also allow you to change the margin (from 001 to 999 in both cases) and paragraph indent settings. Settings are saved with the file. Use the return or cursor keys to get to the value you want to change and type in a new value.

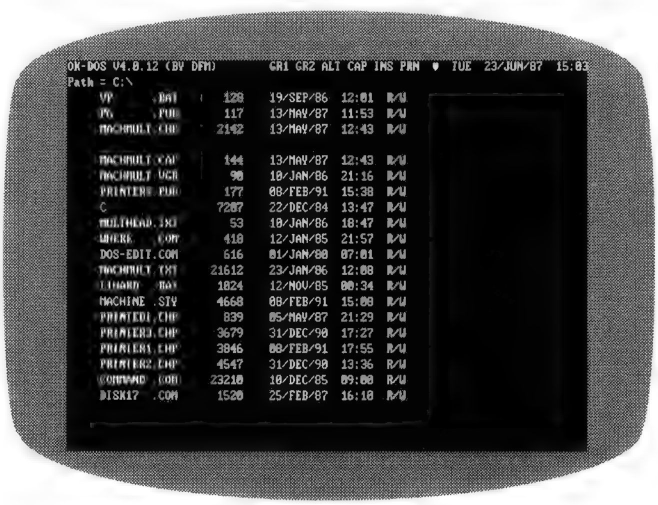
Other options are available too. For instance, columns may be entered into the text, between margin lines. Another feature is the automatic saving of files to disk after a pre-set time to obviate disasters caused by failing to save regularly. The time can be set in the screen format window, from 00 to 99 minutes.

The options continue. You can set a feature which automatically deletes the rest of a word being typed over, or adds space, when the space bar is pressed. You can set the Tab key to move any text, and you can set the Caps Lock key to act as it does on a typewriter, making all keys, numeric included, give their shifted value.

You can also have two spaces inserted automatically after a full stop;



OK4 processing an imported ASCII file



OKDOS in action — doing a directory listing

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and finally you can activate the ability to 'chat' via modem, with a bulletin board, or send files to other computers while running OK4. And that's only the entry screen for a file.

Pressing shift F7 brings up a print format menu. New styles can be defined and saved with a .STY extension. You can set any other of the 20 printer drivers available, choose to use a colour ribbon or sheet feeder, change form length and alter communication parameters.

Screen layout

This is most unusual, even at first glance. It occupies the top four lines of the display area, and is as comprehensive as you could wish.

The top right line shows which version of OK you are using, V4.0 in this case. Next to that is the date and time, error messages, the number of pages being printed, the number of matches in string searches, a flashing heart when the disk is being accessed, and an 'L' when macro logging is taking place.

Below that is a display of the cursor position, by line and column. The name of the file in use is also shown on this line.

The third line has a number of mode displays which highlight when in effect. GR1 and GR2 are highlighted if either of the IBM's graphic character sets is in use. ALT, CAP, INS and NUM are highlighted if Caps Lock, Alt, Insert or Num Lock keys are pressed. PRN glows more brightly if the printer is selected and CDT is active if the modem is in use and a carrier is detected.

After the CDT light, is a blank space — blank unless a character attribute is selected. In that case, underscoring, coloured text and so on are all indicated with an appropriate letter or coloured block. Text with the attribute has the same colour. Finally, there is a 'memory in use' display, with eight dots being highlighted as RAM is consumed. Near the limit, a beep is emitted, and an 'out of memory' error message displayed shortly after. Fear not though, recovery is very simple.

The fourth line is the command line. Pressing Esc places the cursor in this line for the entry of typed commands; followed by Esc to execute.

But the best feature is at the top left of the screen, where there is a miniature display of the keyboard being used. Farewell keyboard stickers. Press shift, and the upper case characters appear. Press F9 to select a graphics character set, F10 to toggle between the two graphics sets, and the key values are instantly seen. It means no guessing which key gives a pi sign, for instance.

There is a total of 24 keyboard sets that can be loaded, including the IBM ones. These embrace the fields of italics, additional graphics, European characters for 16 languages (designed by the University of NSW), super and subscript characters and scientific characters. Some of these scientific characters can be overlayed on standard alphanumeric characters, so any mathematical formula can be typed. This facility comes from Macquarie University. To print special character sets, you need a special 'thimble' file, available from Pricom upon registration.

To load a new keyset, press the Alt key, and then hit Ctrl and choose any one of four keys. You can also specify, in the batch file that starts OK4, which keyboard you are using — PC, AT or whatever, with eight variants possible. This versatility is outstanding.

A ruler line, after all this, seems a bit common. Displayed by pressing Ctrl and F7, it sits below the information displayed at the top of the screen. The ruler shows the indent setting as an A, the margins as Ms, and tab settings with Ts.

Automatic paragraph indenting is set by moving the cursor to the desired place, and pressing F2 and 4 together. OK4 continues until auto-indenting is cancelled, with Shift/Return. Changing margins is done on the screen format screen.

File editing

The four main file functions are opening, saving, printing and quitting. These commands are entered at the command line, basically by their initial letters, followed by the name of the file and its path.

Any file activities are blindingly fast. This file loaded in less than two seconds, complete. Search operations take a second or less. In fact, independent tests have shown OK4 has performed two or three times faster than other word processors. It is all to do with the economy of programming, and the use of both C and Assembler. Speed is a major feature of OK4.

There are options for the open and save commands, prefixed to the command letter. The open file options are opening an ASCII file, and translating it to OK4 format; opening a file without its trailer, so it appears unformatted; opening a file as read-only (don't you wish more word processors had this feature?), and either opening a file with line numbers, or opening a file without line numbers if they are already present. A further option allows a 60k window on a very large file to be opened. Several windows on a large file can be opened in succession, with temporary files being created as each window is saved. At the end of the session, OK4 automatically recombines all the files into a single file, with a .BAK extension.

Up to 63 files can be open at once, and the status window allows for swapping between them. If there are only two files open, Esc, X and Esc on the command line can perform this function also.

OK4 works by loading a copy of a file into RAM, and editing that. The disk file is saved, and given a .BAK extension when the edited file is saved. File loss is likely to be a rare event.

Files can be saved as ASCII, without file trailers, or saved and re-opened, to continue work.

Printing is easy enough. Press the F5 or F6 key to bring up the file status or file directory window; select the file to be printed, press P, and a P appears next to the file name. Select the printer with the F8 key, and away it goes. To see where page breaks are going to fall, OK4 allows you to do a dry run print, displaying page numbers and page breaks on screen. Other word processors call this print preview.

If all goes well, you shouldn't get error messages. If you do, they will appear as a number and a short message on the top line of the screen. You'll get errors if you enter an invalid command, attempt to open a file which is already in memory or is not a word processing file, try to save a file with a name that already exists and so on. The manual details what to do if an error is encountered.

Formats

Cursor movements are extensive, if you can remember them all. Basic movement is with cursor, home and end keys, and nine F3 key combinations. These move the cursor to left, centre or right of the screen top or bottom, or current line.

Speciality movements, using the F4 and another key, move to the start of next or previous words or paragraphs, back or forward a specified number of lines, to column one or the last word plus two spaces. Who needs a mouse?

Tabs are preset to every eight characters, but settings may be cleared with

a keystroke. New tab settings are made by pressing F4 and '+', or entering 'T' and a new tab spacing value at the command line.

Text deletion is on a par with other word processors. Del and Backspace delete to right and left of cursor. F4 and Del delete to the end of the word. Other options delete from the cursor to the end of the line, all the current line or a user-specified number of lines down from the current line. Shift and delete recover accidentally removed lines.

Characters are inserted with the Insert key, and blank lines can be inserted, singly or en masse from the command line.

Text search procedures are provided for, with the search extended even to attributes and colours. Any string up to 31 characters, with wildcards, can be specified, and a match can be deleted, or replaced with new text. Modifiers to the basic commands specify exact match, whole word match and global delete and replace, with or without confirmation. The luxury touches are specifying the number of times a global command will delete or change a text string, and a word count feature.

There is a full range of block commands. Blocks can be marked, then deleted, copied, printed, pasted to another file, or have additional blocks added to them. The Esc/H/Esc command sequence marks start and end of blocks, and they are highlighted on screen. To do multiple copies of a block, simply enter the number on the command line.

Like most word processors, OK4 allows extensive formatting of text. The main facilities are centring of text and paragraphs, justification, bold, italic, and underlined text, super and subscripts and word wrap. All formats are accessed by pressing either the F1, F2 or F3 key and a key in the top row of the keyboard.

Each attribute can be set to affect text as it is entered, (auto mode), or on subsequently selected lines or paragraphs. Some of the names for functions are decidedly odd. For instance, to print italics, you use a reverse video attribute. To print subscripts, you use a setting called vertical rule. Superscript is done with an overscore function. You get used to it in time and the manual is quite clear. It also describes how to undo attributes.

The formatting commands are the most complicated in the program. For instance, to bold text already entered, you position the cursor at the start or end of the text, press F3 and 6, then use Ctrl and space or backspace to go over the text you want bold, turning bold off with F3 and 1. Display of attributes depends on your computer and monitor. With a mono monitor, it is not easy to tell what it will look like.

In fact, if there is any major criticism of OK4, it is the unusual commands. There are no menus, few prompts of what to do next, and you'll need to refer to the manual frequently to get the power out of the program. Once you master it, you'll love OK4, but if you are used to other word processors, be prepared to travel a lengthy learning curve.

Right justification is one option not catered for on screen, though it can be done at printing. Word wrap is though, and can be done at text entry, or paragraph by paragraph. By using the columns option and paragraph by paragraph justification, text can be kept in two or more columns with a little effort. Other word processors are easier to use in this regard, but persevere and you will get the hang of it.

'If OK4 had been developed by Micropro or Microsoft, it would be a chart topper, and cost twice as much.'

Line spacing is one omission from the formatting commands. The default is six lines per inch. By using a printer command, this can be altered, but you don't see the effect on screen.

There are some extra, useful editing commands available by combining the Ctrl and cursor keys. With these combinations, text can be easily converted to and from upper and lower case, or to and from alternate character sets. Another useful command makes an exact copy of the current line to the line below.

Another beauty is by pressing F4 and 9, which puts the current date and time on the screen, as part of the file. F4 and 0 do the same with the current file name.

A few recent word processors have inbuilt commands to perform mathematical functions on numerical text. OK4 does too. Highlight a column of figures or place the cursor on a line of figures separated by '+', type GADD on the command line, and you have your answer. The same command also performs multiplication, if '@' is placed between the figures on a line. OK4 ignores text in between numbers, and you can do a global deletion on the '+' or '@' characters.

GSORT is a related command. If you have a text table, you can highlight the text in one column, and sort it, with the corresponding lines of the table, into alphabetical order. For a large sort, the operation can be done in the background, while other documents are worked on. Other GSORT options give reverse alphabetical and ASCII order sort. It's a handy command for tabular work.

Up to 26 macros can be set up, with the logging command. They are activated by pressing F4 and the relevant key. Four macros are already provided. One combines two paragraphs into one, another creates a new paragraph at the cursor position. A third loads OK Writer, the fourth loads OKDOS. More on these later.

Other macros are set up by typing GPHRASE on the command line, followed by the appropriate key. This starts an 'L' flashing in the top line of the screen, indicating that logging is taking place. Subsequent keystrokes and commands are recorded. When done, turn off the logger, with F2 and 5, and the macro is saved to disk.

The logger can also be used to store keystrokes in a temporary file for use in the same session. F2 and 5 toggles the logger on and off. The file is saved as OKLOG.$$$. This file can be renamed, with OKDOS, for permanent storage and later use if it is again renamed to OKLOG.$$$.

The OKLOG file is run with the Auto Edit command, F2 and 6. It can also be incorporated into batch files, which, with practice, could lead to some very sophisticated, and automatic file handling procedures, due to the ability to loop command sequences.

Want more? How about pressing F4 and scroll lock. This locks the keyboard, and the PC beeps if any keys are pressed. The same two keys bring life back to the keyboard. And how about a command that fills a space with a specified space filler. That's also there.

OK4 includes what is called a lexicon. This is a combined dictionary and spelling checker, of some 5000 words. The developers argue, quite rightly, that dictionaries of a hundred thousand words are unnecessary, as they slow the word processing down. Far better, they argue, to start with a small dictionary, and add your own jargon as you go along.

The lexicon is installed by typing LOK.LEX on the command line. As you type, the computer beeps whenever an

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unrecognised word is entered. You can add unknown words to the lexicon by pushing Esc twice. You can also spell check existing text by moving the cursor to the top of the file and typing Esc, W, Esc, on the command line. The cursor halts at an unknown word, for correction or addition to the dictionary.

The lexicon is updated with a single command, and unloaded from RAM, to save space, with another. It has another feature too — the ability to suggest endings to partially typed words. Press F4 and 7 and a suggested ending will appear in the text. Repeat the process for further suggestions.

The program also has a simple mail-merge facility. A separate file of, say, names and addresses is written. A printer command is embedded in the data file where the form letter is to be placed, with the name of the letter document. Then, write the letter and save it.

Call up the file listing and type P next to the data file name, so it starts to print. It accesses the letter when it is encountered in the name and address file. You'll need to master print commands to use this facility to its full, but it does work pretty well.

Printing

We've seen how to do a print preview, print and queue files for printing. Yes, OK4 does more than that. It has a print pause, a print terminate, a print of the current file from the cursor position, or a print of a marked block of text.

Print commands can be embedded in text. Within a document, they will cause pause or end printing, print labels, print banner text at the left, centre or right, top or bottom of a page, give a page break, change page format, print to the left or right margin, change print modes from draft to letter quality, address a printer in its own commands, change character size, print on both sides of a page and print multiple columns. Read the manual carefully — it isn't complicated, but there is a lot you can do.

Communications

To send files to another computer running OK4, or use a bulletin board, there is a built-in communications module running at 300 or 1200 Baud. Set the communications parameters on the print format menu, then activate the 'chat by modem' option in the help screen, and you are in contact, with text being echoed to the screen. Autodial is supported, for easier access to remote PCs.

Datacomms uses a separate area called the chatting area, selected in the status window. This area must be opened to send or receive text. To send an electronic message, select a block of text, go to the chatting area and type Esc, $C, Esc, on the command line. The block will then be sent. Incoming text comes to the same area, and can be saved as a text file.

To send OK4 files, activate the 'Files by Modem' option in the help window. Open the file display window, select the file and hit 'S'. Off the file goes, as soon as the modem establishes contact with another computer running OK4. Files can be sent and received at the same time, and transmission can be a background activity. An 18 character comment can be typed in to appear on the top line of the screen at the other end of the line. This comment can also be uploaded by the sender.

Aside from the limitation of only being able to send files to another OK4 user, the communications module is useful, and puts OK4 right up with other major word processors.

OKDOS

The final feature of OK4 is a pseudo DOS called OKDOS. Pressing F4 and D brings it into action. It allows you to delete, copy and rename files, get directories, with the lengthier OK4 names if necessary, make, change and remove sub-directories, put and get files to and from another computer, type files and change the date stamp on files.

The display looks just like a normal MS-DOS command screen, though you can display the file status and file listing windows at any time. To return to word processing, press Q and Esc. Restoration of OK4 is almost instantaneous.

In some respects, it is an improvement on DOS. For instance, directories are listed a screen at a time, and file read/write status is shown. OKDOS does all the file manipulation you'd want to do, is quick to access and is a valuable aid to the user.

Documentation and support

This is clear enough, but not as glossy as manuals for better known products. The index is a little inaccurate too, and Pricom informed me that an updated manual will be released by the time this review is published. It does contain extensive troubleshooting charts, and a full comparison of keys for the PC and the NEC APC III.

Help screens are accessed with the F4 and F7 keys. They are comprehensive, though there is no easy way to find a particular section. Scroll till you find the right part.

Mentioned in the manual, though not supplied, is another word processing application called OK Writer. Release of this was postponed by Pricom in order to get the MS-DOS OK4 ready for sale. It is designed for large documents, and has features such as indexing. It will be supplied on registration, and should add handsomely to the value of the packages.

Pricom offers what seems like excellent support. On registration, you get files that enable you to download the alternate character sets. This should discourage some pirates. For $30, you can get a quarterly magazine called OKthusiast. For $130, you get the magazine and future OK4 upgrades.

For $10, to cover the cost of each disk, you can get programs with which to install unlisted printers, another 40 character sets, including Arabic, Hebrew and Coptic, an advanced user support kit, with assembler files for printers and keyboards, and more. It is there, practically for the asking.

Future plans for the product include a cartridge for the Impact line of laser printers which will allow all the character sets to be used, and a Unix version of the program, for mainframes.

Conclusion

OK4 is one of those programs reviewers love. It has so many features, you need to add pages to the review to cover them all. Many features are unique. It is fast, faster than any word processor I have tried. It is compact enough to fit on any PC, laptops included. It is versatile, and able to cope with the myriad of keyboards, screens and printers currently available. It is not so expensive and it is Australian, with good support.

The only criticisms relate to documentation, which is being redone, lack of some on-screen formatting commands and a full WYSIWYG display, and the unusual nature of the commands, which users will soon get used to.

If OK4 had been developed by Micropro or Microsoft, it would be a chart topper, and cost twice as much. It is good enough to take on the big boys, and beat many.

You owe it to yourself to look at this program very closely. It is OK by name, and more than OK by nature.

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Norton Utilities

To many IBM PC users, the Norton Utilities are indispensable. Robert Schifreen looks at the advanced version of this computing 'life-saver', to see if perfection has been improved upon.

To a generation of serious users of the IBM PC, Peter Norton is a hero. His *Programmer's Guide To The IBM PC* is still the best single source of technical information on the machines, and his utility programs have long been a life-saver for those who like to DEL now and think later.

For the uninitiated, the Norton Utilities are a collection of programs for the serious user of an IBM PC or compatible. They are not applications programs, like word processors or databases, but utilities for making better use of your machine or for helping you recover from mistakes. The most well-known part of the package is the set of programs which let you recover a file or directory that has accidentally been deleted from a disk.

Two new versions of the Norton Utilities are now available: Version 4.0 is an updated and enhanced version of 3.1; the Advanced Edition contains everything from Version 4.0, as well as two new programs and a couple of upgrades to the existing ones. The product I'm reviewing here is the Advanced Edition (see the panel for full details of the differences between this and Version 4.0).

The complete package consists of two disks which contain 24 programs. There's also a 175-page paperback manual, a reference card and, in the Advanced Edition, a booklet explaining the technicalities of disk storage on the PC.

The disks are not copy-protected, so to install them on a hard disk you have to make a directory called NORTON and copy everything into it.

The job that the Utilities are famous for is recovering files that are accidentally deleted. If you go out and buy this product because you have just done that, it's essential that you use the programs from the floppy disk, as copying them to the hard disk (or, indeed, writing anything at all to it) will probably make recovery of that file impossible. It's good to see that the manual mentions this early on.

Getting started

Included for the first time is a program called the Integrator. This presents you with a list of all the utility programs down one side of the screen, and, as you select one with the cursor, the other side of the screen shows details of what the program does and how you use it. Pressing Return starts the selected program, and you are returned to the Integrator screen afterwards.

Considering that you can start a program from the Integrator and then return to the Integrator main menu afterwards, I'd love to be able to alter the Integrator program and put my own programs on its menus. Perhaps this facility will appear in version 5.0.

It's impossible to fully describe 24 programs here, so I'll just concentrate on what I consider to be the most important, useful or interesting. The others are described in the panel.

DT — Disk Test

Like DOS's CHKDSK program, DT tests the integrity of a disk and allows you to repair damage. The types of test performed by the two programs are different, though. CHKDSK performs a simpler task — it checks through a disk's File Allocation Table and directory to make sure that the data on the disk is where the directory thinks it should be.

DT, on the other hand, looks for physical errors on a hard or floppy disk. It will search only the part of the disk in use by files, or the reverse (parts containing erased files, the system and directory areas), or both.

If a disk is known to be damaged and you want to be able to take as much information as possible from it before throwing it away or reformatting, DT will allow you to mark an individual cluster as good or bad. When DOS formats a disk, any clusters which give errors are marked as bad and will be ignored by DOS in future. If a cluster subsequently becomes bad, the disk will keep giving errors; being able to mark as bad clusters which DOS thinks are usable will result in the loss of a small part of a file, but allow the rest of a disk to be read.

DT also lets you salvage parts of bad clusters and move them to error-free areas of a disk.

I found DT to be more thorough than CHKDSK at finding errors. DT managed to pick up half a dozen physical errors on a disk, while CHKDSK regarded it as perfect. Armed with the numbers of the dubious clusters (as reported by DT), I could mask them out and get DOS to read what was left of the disk.

FI — File Info

The problem with MS-DOS's DIRectory command is that it doesn't make best use of space on the screen. The filename, size, time and date take up 40 characters. Most users have 80-column monitors, though, so the other side of the screen is wasted. FI allows you to add a comment to a file, and that comment will be displayed in the empty space.

Unfortunately, the DIR command still works as normal. If you want to see the comments you have to type FI instead. Also, FI puts filenames in lower case, which is hard to get used to if you are accustomed to seeing them in capitals.

In order to store the comments, FI creates a file called FILEINFO.FI in every directory which has commented files. On a floppy disk, you may possibly run into problems if disk space is

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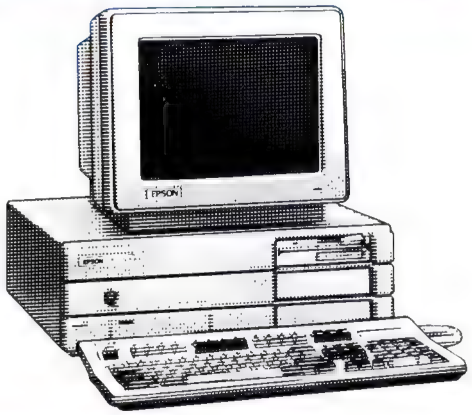

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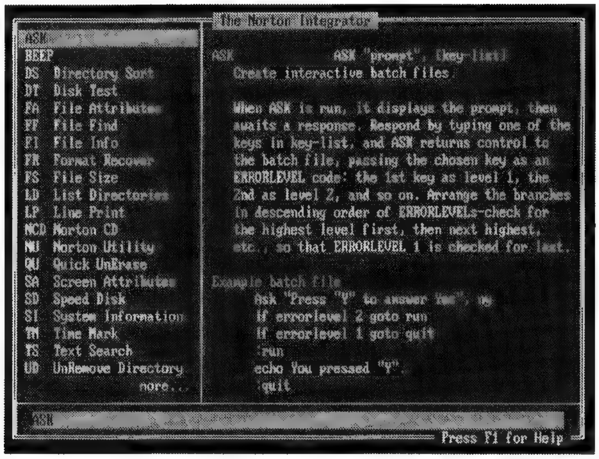
tight and you want to add a comment. The way round this is frequent use of the PACK command, to compress the data file and remove comments for files that have been deleted. This is not normally done automatically, so you should do it often. Another reason for doing it is, if you rename a file to one that existed some time ago, the renamed file will inherit a comment if the erased file had one.

Because FI is not a built-in command like DIR, you have to make sure that MS-DOS's PATH command is set to point to the NORTON directory or wherever you put FI.EXE.

Comments can be up to 65 characters long, though only the first 40 are displayed. To see the full version, you have to use a different form of the FI command which shows only a file's name and does not give its size, date or time.

Wildcards can be used to add comments to groups of files.

A serious omission to FI is the ability to search a disk or directory for a specified comment. You can list out comments, but not search for one in particular and be told which file/directory it appears in. It would be useful, for example, to be able to search for comments such as 'this file not needed' or 'must be backed up daily'.



Included with this version for the first time is the Integrator. This is a separate program that gives a screen of information on each of the utilities, and lets you select and start one from a menu. When execution is complete, you automatically return to the Integrator and not to DOS

FR — Format Recover

Normally, when you format a hard disk, MS-DOS doesn't overwrite what was on it. It just deletes the directory (a special file that tells MS-DOS where files are) and File Allocation Table (which tells MS-DOS where individual parts of a file are, if it has to split them up to use disk space efficiently).

In theory, if you saved the directory and FAT somewhere safe and then formatted the hard disk, replacing the FAT and directory would totally restore the hard disk. In effect, it would reverse the format operation. This is what FR does. You have to tell it to save the information, and you have to tell it quite often, because any changes you make after saving the FAT and directory won't be reflected in the restored version. The manual recommends you put the FR/SAVE command in your AUTOEXEC.BAT file, and the Norton office suggests that you put it at the top of your most-used batch files too.

The information is saved in the data area of the hard disk (this only works on a hard disk), just like a file. Then, if you accidentally format the hard disk, typing FR (assuming you still have FR.EXE on a floppy) will undo most of the damage. I say most, because my experiments resulted in the loss of a sub-directory that contained 69k of data. I don't know where it went, but it was enough to convince me that FR, though useful, is not foolproof. I think I'll stick to using a lower-case volume name and not storing the FORMAT program on the hard disk.

Incidentally, other Unformat programs like Mace don't need to make a copy of the FAT or directory at all. They just go through the ruins of the data, work out where the files must have started and ended, and create a FAT and directory from scratch.

And, more incidentally, some versions of MS-DOS do actually overwrite all the data area of a hard disk during formatting, and not just the FAT and directory, so it's well worth backing up everything to floppies and testing your system first if you plan to use FR seriously.

NU — the Norton Utility

If the Quick Unerase program (see the panel) fails to find all of your missing files, it's time to dig out the main NU program. This is a very comprehensive piece of software that lets you examine just about every area on a hard and floppy disk, and change any of the information on it. You can, for example, unerase a file by pointing to DOS's amended directory entry and recreating the details in a couple of keystrokes.

If the file is fragmented (split up, for efficiency, by MS-DOS to fit into small areas of free space on a disk), NU will make a guess at finding what it thinks is the correct file, in the correct order. The guesses are usually spot-on, though you can drive the system manually when it becomes confused and steer it back on course.

You can edit any file on a disk, which is useful if you want to change a program's built-in settings without resorting to MS-DOS's DEBUG program. Just about the only thing you can't do is look at, and edit, the directory, FAT and partition table — at least, you can't on Version 4.0. The NU program included with the Advanced Edition even allows you to do that.

Unless you know what you're doing, though, a tool like this can be dangerous. The partition table, for example, tells MS-DOS whether a hard disk will boot or not, and which operating system is on it. Change this, and you'll have problems.

If you don't want all the technicalities but just want to be able to restore deleted files, then the manual contains a useful tutorial that guides you through using NU and shows you how to recover a file that is difficult to restore because it was fragmented.

UD — Unremove Directory

If you delete a file and then delete a sub-directory where it was located, you can't restore the file because the directory doesn't exist. First, you have to restore the directory that contains the list of deleted files; then you can reconstruct the deleted file from the remnants of its directory entry.

UD lets you reverse the action of MS-DOS's RD or RMDIR command and restore the directory. Not only is the directory restored, but UD searches

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Other utilities included with the Advanced Edition

ASK: Used in batch files to ask the user a question and take action accordingly to the reply. Coupled with MS-DOS 3.3's ability to call batch files as subroutines from within other batch files, ASK will make it easy to set up a menu-driven MS-DOS environment for new PC users.

BEEP: Sounds the speaker for a given duration and frequency. A set of notes can be stored in a file.

DS: Sorts a directory by filename, extension, size, data and/or time. Will sort in ascending or descending order. Full-screen mode allows individual files to be placed anywhere in the directory listing, so that frequently-used ones will always appear at the top.

FA: Displays, sets or clears one or more of a file's attributes. This is similar to MS-DOS's ATTRIB command, though versions of DOS prior to 3.30 will not allow all attributes to be set.

FF: File Find. Searches all the directories on a disk for a specific file. Similar to the widely used WHEREIS program.

FS: File Size. Lists the files in a directory (and, optionally, all its sub-directories) and shows their size in bytes. Also shows amount of disk space used and unused, and the percentage of 'slack' space — disk space wasted through putting small files into large clusters.

LD: Lists all directories on a disk, and, optionally, the size of each one. It's useful to redirect the directory list to a file and use a word processor to add a comment to each line. You can then produce a batch file that does the same thing to every directory on a disk.

LP: Line Print. Prints a file to the printer, with optional line numbers and time and date header. Page size and column width are configurable. Will optionally strip the top bit from all characters, so WordStar documents can be handled.

NCD: Norton Change Directory. An improved version of DOS's CD command that is intelligent enough to let you change to a unique directory without forcing you to type the full pathname.

QU: Quick Unerase. If you accidentally delete a short file that spans only a couple of clusters, it's possible to recover it almost instantly by typing QU followed by the filename.

SA: Screen Attributes. Sets the foreground, background and border colours to be used by DOS. There are pros and cons to this program. Annoyingly, it uses the ANSI.SYS driver so it won't work unless ANSI.SYS is loaded. What's helpful is the choice of English-like parameters, for example: SA BRIGHT WHITE ON BLUE.

SD: Speed Disk. Optimises a hard or floppy disk by rearranging all the clusters that make up files so that they are contiguous — that is, not split up into fragments. Such a program is only really of use on a hard disk and, in theory, should speed up access times if the disk is nearly full. Unfortunately, the program managed to lose two batch files when I tried it, and I immediately lost confidence.

SI: An enhanced version of the System Info command, producing the Norton Index for a machine, much used by reviewers to indicate how much faster than the original IBM XT a clone runs. The new version gives separate ratings for disk and processor times, as well as an overall rating.

TM: A stopwatch, accurate to a second (actually four stopwatches that can be examined, stopped and started independently. Useful for timing how long you spend online).

TS: Text Search. Searches a directory, group of files or entire disk, to find any files that contain a specified string. Will optionally search only areas of a disk containing erased files, so you can then unerase that file with the NU program.

VL: Similar to DOS's LABEL command, that lets you put a volume label on a disk. Norton's version allows you to put lower-case letters in the label, while DOS does not. Before formatting a hard disk under DOS you have to type the volume label, and the volume label on the disk must be in upper case. Using Norton to put a lower-case label on a hard disk makes it harder to inadvertently format a hard disk.

WIPEDISK: This program is deemed powerful, so it has a real filename and not just two letters. It removes any traces of a file from a disk, preventing it from being unerased, even by the Norton Utilities.

WIPEFILE: A less drastic version of WIPEDISK.

the disk for deleted files that were once in the now-restored directory. The files aren't automatically unerased, but if you haven't saved much to disk since erasing them, it's fairly easy to retrieve with QU.

Prices

Version 4.0 costs $185. The Advanced Edition is $303. To upgrade from version 3.0 to 4.0 costs $51 or from Version 3.0 to Advanced Edition is $72.

Conclusion

It's a fact of life that insurance, although a life-saver, is never cheap. Norton's Utilities earned their name as insurance against deleting files from a hard disk and — make no mistake — that is what they still are. While it may be useful to have an easier way of changing directories or finding a file or its size, there are plenty of programs around that will do this for you; just ask you local user group. And the average user would be well-advised not to explore the innards of hard disk just for fun.

When it comes to undeleting files, Norton has a reputation and it's this which keeps people buying the software. If you use a hard disk for programming or any other serious use, having something like Norton around is good insurance. You'll hardly ever need it but, when you do, you'll thank yourself. For this purpose, I found the programs worked well (though I don't trust Format Recover) and the manual makes a good job of guiding you through the process. Version 4.0 is a worthwhile investment to keep for emergencies, though I see no reason at all for buying the Advanced Edition — Speed Disk (see the panel) is far from reliable and Format Recover isn't worth the risk.

If you already have an older version of Norton, it's worth upgrading only if you have a specific task in mind and your current version won't do it.

As a general protection against accidents, neither Version 4.0 nor the Advanced Edition are significantly better than Version 3. They may be slightly easier to use, and the menus rearranged, but that's no reason for upgrading.

END

Warning

After my experience with Speed Disk and the loss of two files, I took the particular program home to investigate further. It lost the entire contents of my 20Mbyte disk and, although I subsequently performed a low-level format, all is still not well. If you intend to use Speed Disk, back up your disk at least once before you do anything.

Both versions of Norton Utilities are available from PC Extras on (02) 319 2155.

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Ready, Set, Go! 3

The race to produce desktop publishing packages has been fast and furious, but one worthy competitor which got off to a slow start is making up for lost time. John Donaldson tests Ready, Set, Go! 3.

When Apple Computer invented the concept of 'desktop publishing', the product it chose to spearhead its drive was Aldus' Pagemaker: this package brought the power of dedicated publishing systems onto the desks of Mac owners. Around the same time another desktop publishing package was launched called Ready, Set, Go!. Unfortunately, Pagemaker was much better than Ready, Set, Go!, so people didn't take much notice of it.

Now the package has been almost entirely re-written and has re-emerged as Ready, Set, Go! 3 (from now on RSG3). It boasts all the latest features such as hyphenation and kerning, and looks set to knock Pagemaker right off its perch.

In use

Ready, Set, Go! 3 is supplied on two 400k Mac disks. The first contains the usual Mac system files including the laser printer drivers; while the second contains the RSG3 program file and the dictionary for the spelling checker. None of the files are copy-protected, so it's easy to copy the program onto hard disks or to make back-ups onto 800k Mac Plus drives.

The program is started in usual Mac style by double-clicking the RSG3 icon. When the program has loaded, the screen divides into a number of sections with the main window displaying the page layout of the current publication; it *is* possible, however, to have more than one publication loaded at any one time with each publication displayed in its own window. The only limit on the number of publications which may be loaded is the amount of free memory in your machine.

The page can be viewed in a number of different scales ranging from 'double size' through 'full size' down to 'size to fit', which displays the whole page in miniature within the window. One restriction is that RSG3 only allows you to lay out one page at a time, so it isn't possible to lay out a spread in the same way as Pagemaker 2. Using the 'Facing Pages' command from the 'Special' pull-down menu, you can see how a spread will look — but you can't change it.

QUICK BROWN FOX JUMPS OVER LAZY DOG!

Mystery surrounds the fate of the sheep and its wool. Hope fading for lambs.

The quick brown fox jumps over the lazy dog. Baa baa black sheep have you any wool? Yes sir yes sir three bags full. One for the master, one for the dame and one for the little boy who lives down the lane!!!

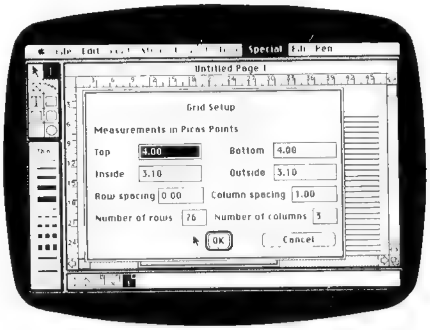
The finished page shows how text can be made to 'run around' a picture block. The text in the headline is Times Roman 36-point which has been 'closed up' by one point to make it compact (original reduced by 34 per cent)

To the left of the publication window there are two toolboxes. The top box contains icons which allow you to manipulate graphics and text and draw lines, ovals and boxes, while the bottom box allows you to choose from a range of line-styles and widths.

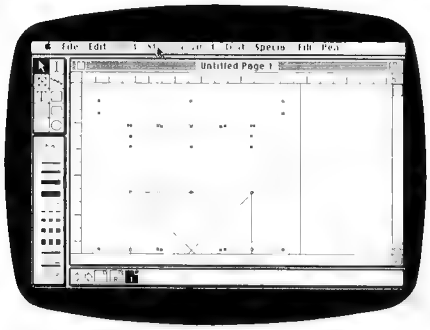
Running along the bottom of the screen are icons representing the pages of the publication. The first two of these are left and right-hand 'Master Pages'. Anything placed in these two pages can be duplicated onto all subsequent left or right-hand pages.

If your publication has more than twenty pages, then the left and right arrow icons can be used to scroll through the pages until you find the one you want. It is also possible to use the 'Go to page' command from the Special pull-down menu to go directly to any page.

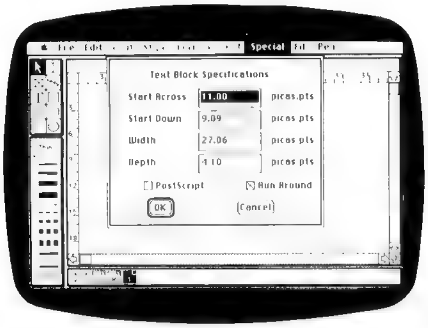
One of the main features which sets RSG3 apart from programs such as Pagemaker is the way that it keeps the design of the page totally separate from the words and pictures which are eventually placed in the design. With Pagemaker, you place text and graphics as you go along until you end up with a completed page. Although this makes the page layout easy to visualise, it does make it very difficult and time-consuming to repeat the same basic design on a number of different pages. To achieve a finished page using RSG3, you first have to create a design and then place your text and graphics.



'Grid Setup' can be used to design grids to your own specification, in this case 76 lines over three columns



Before you can place the text, you must design the page using text and picture blocks



All objects on the page have an associated specifications sheet, which is very useful for positioning objects

Design

The first thing to do when you want to design a page using RSG3 is to set the page size; it's all too easy to forget to do this because RSG3 makes no attempt to remind you that it should be done. This is exacerbated by the fact that the program invariably defaults to something other than the A4 paper size which is the most common in Australia. Pagemaker, on the other hand, forces you to set the page size before it allows you to do a layout.

Another shortcoming of RSG3 is that it only supports the standard Mac paper sizes. There is no provision for A3, for example, or for the custom paper sizes allowed by other page-layout packages. Round 1 to Pagemaker.

It is also a good idea at this stage to set the unit of measurement in which you want to work. RSG3 supports inches, centimetres, picas and points. I found that inches was the most useful setting because RSG3 allows you to position objects to the nearest thousandth of an inch. If you use centimetres, for example, you can only work to the nearest millimetre which isn't as accurate.

The second stage of page design is to decide on a grid. The idea of using a grid as a basis for the design of a page goes back to 1946 when a system called Modular was patented by the infamous French architect LeCorbusier (yes, the same man who gave the world the idea of the tower block). The idea of using a grid is to provide a framework on which to base your page design. Apart from anything else, it makes it easy to get everything on the page to line up correctly.

The size of the grid can be defined by selecting 'Design Grids' from the Special pull-down menu. This allows you to choose from predefined grids ranging from one row by one column up to eight by eight. If this is not to your liking, you can select 'Grid Setup'. This allows you to define your own grid including the number of rows and columns and the size of the gaps in between as well as the top, bottom, left and right margins.

After you have designed the grid, every object you place on the page will automatically snap to the nearest grid point. If necessary this 'snap to grid' feature can be turned off from the Special menu.

As soon as all the preliminaries have been completed, you are ready to design a page; design is achieved by placing objects on the page. All the available objects are represented by icons in the toolbox in the top left-hand corner of the screen, the majority of which will either be text blocks or picture blocks. As their name implies, these contain text or graphics respectively.

To design a page, you decide where you want the text to be and place text blocks on the page in the appropriate places using the Mac mouse. Text blocks are represented on the screen by white rectangles and they can be moved, expanded and compressed using the standard Mac techniques of grabbing a section of the rectangle and pulling it into the required shape.

When you have created the text blocks for a publication, you link them together using the linker tool from the toolbox. Linked blocks need not be next to each other: they can be anywhere, in any order, within the publication.

When text is read into a linked text block, it automatically flows from one linked box to the next along the chain. This is different from Pagemaker where you have to manually flow text down each column in turn. The main problem with linked blocks in RSG3 is that the links are not shown on the screen, so if you have a number of different chained stories within one publication, it can be difficult to remember which block is linked to which.

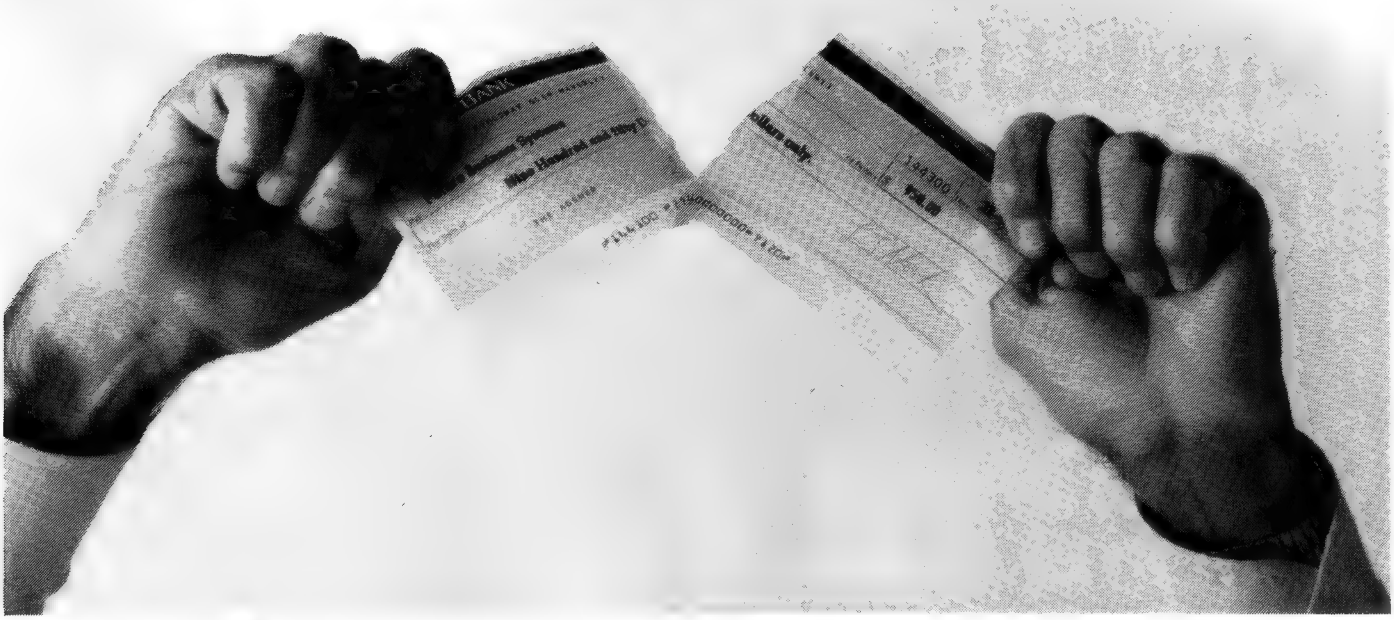
Next, you decide where you want to position the graphics and place picture blocks in the appropriate places. Picture blocks are represented by a rectangle with a large cross drawn along its diagonals. Finally, using the remaining tools from the toolbox, you can draw on any lines, boxes or circles needed to complete the design. Boxes and ovals can be filled with any of the standard Mac patterns, allowing you to generate a number of patterns and greyscales within a publication.

One of the most useful features of RSG3 is that every object placed on the page has an associated specifications sheet which can be called up by selecting 'Specifications' from the Special pull-down menu.

The specification sheet displays the position of each object on the page along with its exact size. This means that you no longer have to rely on your eye when drawing on the screen. If you want a text block which is 1.3454ins wide by 4.5639ins deep, you just type the numbers into the specification sheet and the system will re-draw the box to that size.

The specification sheet also allows you to select the attributes of objects, one of the most useful of which is 'Run Around'. You can specify that if any text comes into contact with a runaround object, the text will be laid out so that it avoids the object. Say, for example, you had a page with three columns of text and you wanted a picture to be positioned in the centre of the page so that it took up the whole of the central column and half of the outside columns.

If you positioned the picture block in this way, the text would automatically make way for the picture block and run around its edges. This is very useful, and means that you can play around with the position of pictures with the text automatically reflowing each time you move the picture.



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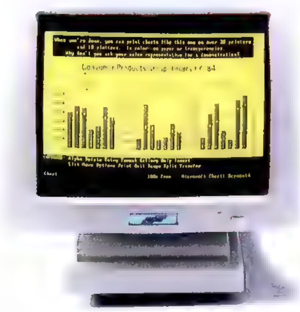

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The only gripe with the runaround facility is that it can only run around oblongs. If your picture is circular or an irregular shape, then the text will flow in a straight line. Not much use. Having said that, Pagemaker can't handle runaround at all.

One of the interesting attributes which can be assigned to a text block is 'Postscript'. This allows you to embed a Postscript program within a text block. When the page is sent to the printer, instead of printing the text it runs the program and displays the result within the text block (if you get your coordinates right). This is a very powerful feature and means that experienced Postscript programmers can produce quite professional results.

One of the advantages of keeping the design of the page separate from the text and graphics is that once you have designed one page, you can then copy it to all the other pages of your publication simply by selecting 'Insert Pages' from the Special pull-down menu. It also means that you can store a number of different standard publication layouts on disk and then just call back the appropriate layout and insert the text and graphics. However, if you do this you have to be very careful with filenames when you save the publication, otherwise RSG3 will overwrite the master layout.

Text

When you have completed your design, you can start to insert the text and graphics to create the finished page. Text can be entered in two ways: either it can be imported from popular Mac word processors; or it can be typed directly into the text blocks in the layout.

RSG3 can import word processor files from either Macwrite or Microsoft Word; it can also read ASCII files. Text mode is entered by selecting the editor icon from the toolbox and then selecting the text block on which you want to work. To import text you select 'Get Text' from the 'File' pull-down menu. A list of available files is then displayed and you select the one you want.

The program then proceeds to run the text into the text block. If the file is longer than the text block, the text will run on into any linked blocks. If there is more text left at the end of the last block, then the program puts a mark after the last block to show that there is more text to come.

Text imported from the word processor files keeps all the attributes it was created with, with the exception of tabs and indents which have to be set up separately within RSG3. As text is run into the text blocks, words are automatically hyphenated as necessary. This automatic hyphenation is one of RSG3's claim to fame because Pagemaker 1.2 doesn't have this feature. Although it worked well, I found that RSG3's hyphenation program tended to get carried away with itself and ended up 'showing off' by hyphenating far more words than necessary. A page with too much hyphenation can look worse than one with no hyphenation at all.

Instead of using a proper hyphenation dictionary, RSG3 comes with an algorithm which it uses to decide where and when to hyphenate a word. The problem is that the English language is illogical, so applying such a set of rules often produces the wrong result. To get around this, RSG3 comes with a user-definable exception dictionary where you can list the words you don't want hyphenated. This can be tedious to maintain.

As soon as the text has been entered — either by importing it or by typing it

yourself — RSG3 provides a number of powerful functions for manipulating the words, such as 'Find and Replace' and a 'Spelling Checker'. The program also allows 'Glossaries' where frequently used sections of text can be assigned to a key and then recalled with a single keystroke. Up to nine different tabs can be set, along with the indent and whether the tab is flush left, flush right, centred or justified. Text can be edited using the traditional Mac interface using the T-beam cursor, and highlighting text to be worked on using the mouse. The font, point size and style of the text can be selected from the 'Font' and 'Style' pull-down menus. Point size can be specified in one-point increments.

As you would expect of a full-page layout package, RSG3 also contains some sophisticated text manipulation facilities: for example, line spacing can be set to automatic or specified in one-point increments. I would have been happier if spacing could have been specified in fractions of a point because often you don't need a whole point of leading. A magazine, for example, might be set in nine on nine and a half-point.

One of RSG3's other claims to fame is its ability to do 'kerning'. This is the method of reducing the spacing between certain pairs of letters to improve the look of the type. For example, the combination 'AV' looks better when the letters are closed up. Each typeface comes with a kerning table containing the letter pairs which can be kerned. Selected text can be kerned in RSG3 by selecting 'Kern' from the 'Format' menu.

In addition to automatic kerning, RSG3 also allows you to alter the letter-spacing of the selected text manually. This is done by holding down the Command key and pressing the left or right arrow keys on the keyboard. Hitting the right arrow will increase letter-spacing by one point while the left arrow decreases letter-space by one point. This can be very useful for making headlines fit or for creating interesting typographical effects.

As well as being able to alter the horizontal position of letters, RSG3 also allows you to move letters vertically above or below the baseline. This is achieved by holding down the Command key and pressing the up or down arrows. Again, all movements are in units of one point.

Graphics

To place a graphic on the layout, you have to select the cropping tool from the toolbox. Using the cropping tool you can select the picture block where you want to place the graphic. Once the picture block has been selected, it is marked out with a series of horizontal squiggly lines.

RSG3 can read graphics files from MacPaint and FullPaint as well as from MacDraw and MacDraft as long as the files are stored in PICT format. As usual, if you are using a laser printer it is better to stay away from MacPaint-type bit images because you lose a great deal of quality. Graphic files are read into RSG3 by selecing 'Get Picture' from the 'File' menu and then selecting the file you want.

When the program has retrieved the picture, it is displayed in the picture block. If the graphic is larger than the block, then the picture block acts as a window onto the graphic. You can use the mouse to move the graphic around under the window until the correct portion of the picture is displayed. Unlike Pagemaker, RSG3 doesn't allow you to scale a graphic using the mouse. The only way to scale a graphic is to call up the Specifications box for the picture block. This allows you to specify percentage vertical and horizontal scaling which can then be applied to the graphic. A word of warning, though: working out the percentages in your head can be tricky — it's much easier with a mouse.

Documentation

The documentation supplied with RSG3 consists of a 64-page 'magazine' which was prepared using the program. The first section contains a quick getting-started feature while subsequent sections cover the program's features in greater depth.

My first impressions of the manual were not good. I like a manual to look like a manual. However, after a month of use it has grown on me. My only gripe now is that according to the manual it is possible to create white type on a black background, but for the life of me I can't work out how.

Conclusion

I am very impressed with RSG3: it is both easy to use and powerful. When it was first launched, it set out to beat Pagemaker. For my money this version is also more powerful than Pagemaker's version 2.

END

RSG3 costs $695 or $168 to upgrade from version 2, and is available from Imagineering on (02) 697 8666.

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CHECKOUT

Hercules InColor

The Incolor GB222 card from Hercules is an enhanced colour graphics card for the IBM family of machines, which lets you design your own colours and fonts. Dick Pountain tests its strengths.

The IBM PC has graphics adaptors the way dogs have fleas. The recent launch of the Personal System/2 (Benchtest, *APC* May) introduces no less than the fourth graphics standard in so many years (CGA, EGA, PGA and now VGA, to get acronymic). You might think, therefore, that this is probably not a good time for a third party to launch a graphics card which is not merely an Enhanced Graphics Adaptor (EGA) clone, but sets a new proprietary standard. If the company responsible were any but Hercules, you'd be right.

Hercules was possibly the first company to get rich by offering cures for the deficiencies of the original PC. It produced the Hercules Graphics Card which permitted hi-res monochrome graphics to be performed on the previously text-only IBM monochrome monitor (the monitor most business users buy). So successful was this card — largely thanks to demand from the millions of Lotus 1-2-3 users — that it became one of the graphics standards, and it is a foolish software house indeed which omits the card from its installation menu.

Last year Hercules introduced an upgraded Hercules Graphics Card Plus, which featured an innovatory system of soft typefonts called Ramfont and permitted appropriately written software to display multiple fonts onscreen. Now Hercules has gone the whole way. The InColor GB222 Card, the subject of this review, is an enhanced colour graphics card which includes the Ramfont capability. As expected it is more capable than the IBM EGA card, but less expectedly it turns out to be more easily exploitable by existing software than the EGA is.

Hardware

The InColor Card is a half-length board which occupies a single slot in a PC, XT or AT. It requires an EGA standard colour monitor (22KHz horizontal and 60Hz vertical scan rates) and will not work with lower resolution CGA monitors; I used a NEC MultiSynch multi-standard monitor on an IBM PC. Like previous Hercules cards, it is not happy co-existing with other colour cards, so if you have a CGA or EGA it would have to be removed. Clones such as the Amstrad PC1512 which have a CGA equivalent on the motherboard may not be able to use InColor. As a bonus, InColor throws in a parallel printer port, configured as logical device LPT1; again this may clash with a previously present port, but in this case the answer is to reconfigure the latter as LPT2.

The basic video specification of the board is that it produces a display of 720 x 348 pixels (rather better horizontal resolution than the EGA) in 16 colours chosen from a palette of 64. In

text mode this permits a character matrix of either 9 x 14 pixels which is sufficiently large to support different fonts, or 8 x 14 pixels with 90 characters per row. In high-res graphics mode it can plot 720 x 384 pixels in a full 16 colours; unlike IBM adaptors it does not employ different modes which trade off colours against resolution.

The card contains 256k of display memory organised as four bit-planes of 64k each. Each bit-plane represents one of the colours red, green, blue and grey (or intensity); the displayed picture is the result of superimposing these four planes. The display memory can be partitioned in three different ways according to mode:

- In Text mode only the lowest 4k of memory is used, the rest being wasted; characters are supplied by a hardware character generator which is compatible with the IBM character set. This mode guarantees that all existing text-only programs will run properly.
- In Ramfont modes, the lowest 16k of memory (in each plane) is used as a text display buffer and memory above this is used to store font data. There are two Ramfont modes. In 4k mode only a single font of 256k characters can be loaded, and this then becomes the standard character set you see on the screen. In 48k mode all the rest of display memory can be used for fonts, up to 3072 characters' worth. This will enable word processing and desktop publishing software to display up to 12 different typefaces on the screen simultaneously. However, in this case each character must be addressed by a 12-bit code rather than the usual 8-bit ASCII code; this means that only specially written software can access it. 4k Ramfont mode, on the other hand, is compatible with all existing software, as it uses standard ASCII codes. You load a font from disk, using the supplied program RAMFONT.COM and all your software then appears in that font.
- In Graphics mode all of the memory is used for two pages of hi-res graphics. These can be displayed alternately, in the technique called double buffering, so that one page is being updated while the other is displayed, allowing a smooth transition between pictures.

InColor does not contain a graphics co-processor, nor any hardware assistance for raster block moves (a so-called 'blitter') such as is found in the Amiga. However, it is a good deal smarter than the totally passive IBM EGA: it could most accurately be described as an 'active display controller'. The main engine is the venerable 6845 Display Controller chip as used on the IBM CGA card. Hercules has added two custom ICs which extend the capabilities of this chip considerably, and combine with the bit-plane organised memory to give excellent performance.

Unlike the older IBM graphics adaptors, the InColor card does not store colour attributes in display memory. Each bit-plane is a simple bit-map, with one bit per pixel, as on a black and white display like the Macintosh's. One immediate advantage of this is that it provides compatibility with the older monochrome Hercules cards — one InColor bit-plane is equivalent to a monochrome screen. Another advantage is that pixels can be manipulated independently of their colour; colour is imposed by the contents of registers on the card, and can be changed virtually instantaneously.

'Some programs, like SideKick, will lock up when first booted; the solution is to tell them you're using a monochrome display. It seems paradoxical, but it works and you get all the colours.'

The custom ICs extend the 6845 instructions by adding a number of 8-bit logical operations on byte values. Pixels are handled eight at a time (eight adjacent pixels are called a 'raster'), and the four bytes (one per colour plane) that represent the raster are handled in parallel by copying them into a 32-bit register on the card called the 'Source Latch'. From this latch, an 8-bit mask is produced which is sent to the CPU and allows it to set any pixel to any colour. This mask is called the BBM (Background Bit Mask) and it tells the CPU which pixels in a raster have (or alternatively don't have) a specified colour. The Source Latch can also be used to protect a specified pixel from modification. Unlike a true co-processor, InColor does not take the load of graphics manipulation away from the CPU completely; instead it makes the load less taxing.

The colour registers require 6-bit values specifying one of 64 colours. The four bits which represent a pixel are, therefore, used to index a table of sixteen 6-bit registers called the Palette, and copy the found value to a colour register. The Palette can be changed by the user with supplied software utilities, or under control of specially written applications programs so that a different 16 colours become available.

In use

The InColor Card produces a very high-quality display, noticeably crisper than that of the IBM EGA thanks to the greater horizontal resolution. Unlike the EGA, it can be used to alter the colours of applications programs originally written for the IBM CGA or even the monochrome adaptor.

The Palette is controlled by two supplied programs called SETCOLOR and PALETTE. Both are interactive programs which display a colour chart and allow you to step through the colours by pressing the space bar. A set of colour choices can also be saved as a file and then recalled by, say, SETCOLOR <filename>, perhaps from a batch file.

SETCOLOR is the simpler of the two programs to use, as it only alters five colours — the foreground and background colours, highlighted colour, 'underlined' colour and cursor colour. These correspond to the screen attributes used by monochrome software and such software will appear in colour if it is reasonably well-behaved (that is, it doesn't bypass the operating system).

PALETTE allows all sixteen colours to be altered. These map onto the colours 0 to 15 used by the IBM CGA, so well-behaved programs written for colour will use them correctly. 'Well behaved' in this context is a fairly loose affair, as I found that SideKick, PC-Write, Lotus 1-2-3 and other distinctly non-kosher programs worked fine. Of course, the five monochrome 'colours' are included among the 16, so PALETTE subsumes SETCOLOR.

The colours available are superb, ranging through subtle tints to full intensity, though the steps between tints are more noticeable than on an analogue system like the Amiga. Since all good IBM programs allow you to install the colours they employ, you ultimately get more control than you do by dragging the sliders in the Amiga Preferences screen. I was able for the first time to find a colour scheme that I'm complete-

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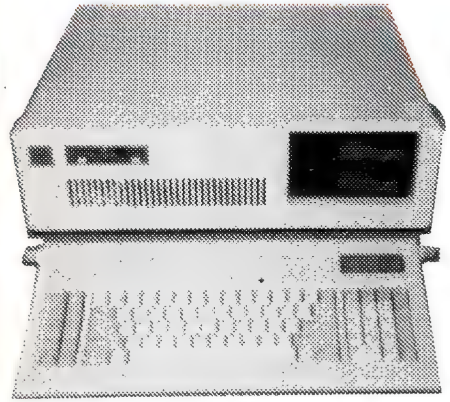

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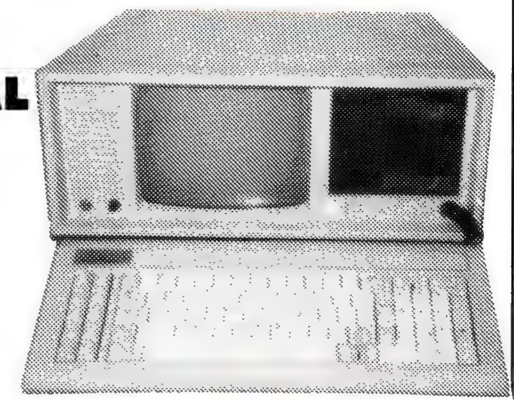

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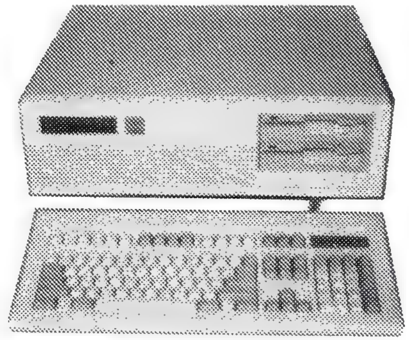

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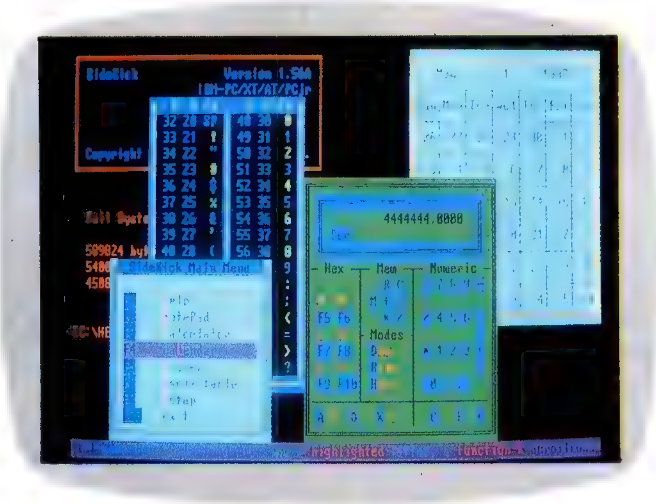
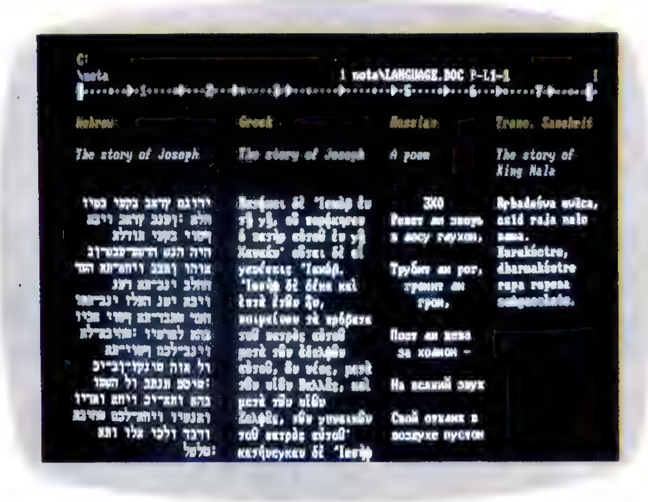


By using the Palette program, even ordinary programs like SideKick can be coloured to be as lurid or as tasteful as you wish



OUP's Nota Bene makes use of the multiple fonts to represent a number of different alphabets — producing graphics with text-mode speed

ly happy with for word processing, namely black on a 'parchment' beige tint. The only fly in the ointment is that InColor does not allow you to set a border colour as the CGA did, and so a reversed screen is surrounded by an ugly black band; however, since the EGA doesn't support a border either, I can't be too harsh.

Fonts are loaded by the utility RAMFONT, and 25 examples of 4k fonts are supplied on the disk. These range from the attractive (sanserif) to the bizarre (fake handwritten script and medieval runes). The PC-DOS prompt in runes looks pretty weird. As on all computers I've seen, including the Macintosh, the italic font looks dreadfully jaggy. A minor problem with the fonts is that the tone characters (code 176, 177, 178) do not join up to form a uniform tint; the box-drawing characters (codes 179 upwards) are properly expanded to nine pixels and do join up.

A full Greek alphabet is one of the fonts, and other foreign-languages fonts such as Cyrillic and Hebrew are on the way. No programs I tried objected to using these fonts, though some home-brewed programs which mess with that part of memory corrupted the fonts, producing odd-looking results. It is not possible to load 48k fonts from the keyboard; this has to be done by actual applications and there aren't many on the market yet.

A very sophisticated font editor called FONTMAN is supplied, which goes far beyond simple fancy-font programs and is aimed at developers writing applications for 48k Ramfont mode. As well as the usual grid editor for characters, it permits copying ranges of characters from one font to another; searching for bit patterns throughout a font; the symbolic naming of fonts or ranges of characters; and logical combinations of characters using AND, OR and NOT. It's also very quick compared to similar programs I've used.

For programmers who need to get to grips with InColor's new architecture, a software simulator called LEARN222 is supplied, along with its source code in Turbo Pascal. This is an interactive program which displays the contents of the InColor registers down the side of the screen. You can enter graphics instructions directly and observe their screen effect in the central window. A Display List of these instructions may be written as an ASCII file and then loaded and executed in single-step fashion. I found it to be an invaluable learning aid.

What about performance? The InColor card provides slick, flicker- and snow-free scrolling that will be a relief to oppressed CGA users. Hercules claims that InColor also dramatically increases the scrolling rate of many programs. I ran the *APC* scrolling Benchmark TextScrn in BasicA, Turbo Pascal and LMI PC-Forth, and the results were confusing. Both Basic and Turbo showed a mere 10 per cent increase in speed, but PC-Forth showed an increase of more than 100 per cent (from 66 down to 26 seconds).

Drivers

Not all programs run in pure text mode, and those which need graphics modes will not run immediately on the InColor card. Hercules has, therefore, supplied some screen drivers for popular applications such as AutoCAD, Lotus 1-2-3, Symphony and Manuscript, Microsoft Word and Windows, and Ashton-Tate's Framework II and Javelin. These drivers vary considerably in the extra features they provide. There are four alternative drivers for Lotus 1-2-3 (which you put into 1-2-3's normal Driver Library); all provide graphs in 16 colours, while some give more characters onscreen (90 x 25 or 90 x 38) or the facility to have graphs in a pop-up window on the spreadsheet screen.

Compatibility

I found that the InColor card provided remarkably good compatibility with old monochrome and CGA software, especially considering its very different architecture. Not every program ran straight away, but only minor tweaks were needed.

One factor that may intrude is memory organisation. As described above, InColor uses three different memory maps according to mode. Most applications switch it to the correct mode automatically; a few, such as Lotus 1-2-3 version 1A, don't. The solution is to set the mode explicitly using the supplied HGC utility: HGC DIAG sets text mode; HGC HALF sets

ple floors in the same building, for example — either coax or higher gauge shielded cable is preferred. Networks that span larger geographical areas — such as between buildings — most often use fibre optic media.

In general, the trend is toward fibre optic media. A consensus is developing for a standard 62.5-micron core; 125-micron-cladding fibre was originally designed for moderate-distance links between telephone switching offices. Because it transmits light, fibre cable can provide communications speeds 10 to 100 times that of copper media.

Other advantages to fibre media include the following:

- Small size and weight — a single fibre can be used to replace a 300-pair telephone trunk cable.
- Immunity from electromagnetic interference — especially important in environments such as hospitals, manufacturing sites, and television studios where copper media can easily pick up electromagnetic noise.
- Security — the fibre cable must be broken to be tapped.
- Non-electricalcharacteristics— fibre media can be used in hazardous environments such as oil refineries or where electrical code would not permit wiring above suspended ceilings.
- Low signal loss — this allows networks to embrace larger geographical areas.

Fibre optic technology is still in its infancy. Improvements in fibre transmitters and receivers will greatly increase the bandwidth of existing fibre media. The major disadvantage is cost. Because this is still a specialised industry, components and installation cost substantially more than an equivalent copper network. As more fibre is put in place, these costs can be expected to drop.

'delay time in CSMA/CD can be expressed only statistically; in the worst case . . . a station may be blocked indefinitely.'

Recently, an ANSI committee (X3T.9) published a standard for a variant of the 802.5 token ring that operates on high-speed fibre media. The Fibre Distributed Data Interface (FDDI) defines a token-ring network that communicates through fibre at 100 Mbps. Up to 500 nodes can be placed on the network, which can be as large as 100 kilometres in circumference. FDDI's most innovative feature is fault-tolerance: the ring can recover from a cable break or station crash without intervention. This reliability is accomplished with a second counter-rotating ring. When two stations detect a break between them, they redirect traffic to the secondary ring, reestablishing the connection.

Standards for the future

Each of these LAN hardware standards has characteristics that make it a commendable design choice for a particular environment. The CSMA/CD protocol is relatively simple, works well at low to medium network utilisations, and is widely implemented by a variety of manufacturers on many types of media. Most LANs that are not time

one page of graphics; and HGC FULL sets both pages. For Lotus 1A you use HGC FULL (perhaps in a batch file). HGC alone resets the card, which is important as an IBM warm boot doesn't.

The other factor which may give problems is that InColor occupies IBM memory space starting at \$B000:0000, rather than \$B800:0000 as the CGA does. In other words, it looks like a monochrome adaptor to programs. Some programs, like SideKick, will lock up when first booted; the solution is to go into their Install program and tell them you're using a monochrome display. It seems paradoxical, but it works and you get all the colours.

Conclusion

I was impressed by InColor's performance in a way that I never was by IBM's EGA. It's important, however, to be clear in your mind about what it can and can't do for you.

InColor is not a supercharged graphics co-processor card. If you're into CAD/CAM then you'd be better buying one of the new TI 34010 cards and a 1024 x 1024 analogue monitor.

InColor is not an instant solution for desktop publishing. The Ramfont capability is confined to the screen and does not translate onto paper without the usual fancy and expensive software and a laser printer. However, it will make desktop-publishing software for the PC more attractive to look at, and more similar in feel to that on the Macintosh.

InColor is aimed at everyday PC users, and provides a quality of display which is the equal of the best in the business. More importantly, it can do this for most existing software, thus preserving your investment in time and money. In this respect it's more flexible and usable than IBM's own EGA card. IBM's new VGA standard offers much higher performance, but whether it will retro-fit to existing PCs is not yet clear.

As to the question of future software support, Hercules is the leading independent graphics vendor for IBM, and all the major houses are likely to support InColor and Ramfont.

At \$1100 the InColor card is not exactly cheap, and a suitable monitor will cost another \$1200 or so. Nevertheless, if I were buying an AT clone, it would be my choice of display system.

END

The InColor GB222 card is available from Tech Pacific on (03) 690 9055.

Loud and clear

The problem of speech synthesis has been tackled and successfully overcome by computer scientists, but voice recognition is a more complex issue altogether. Nick Hampshire traces the progress so far.

To the computer scientist, the challenge of creating a computer system capable of conversing with its human users in a natural spoken language is enormous.

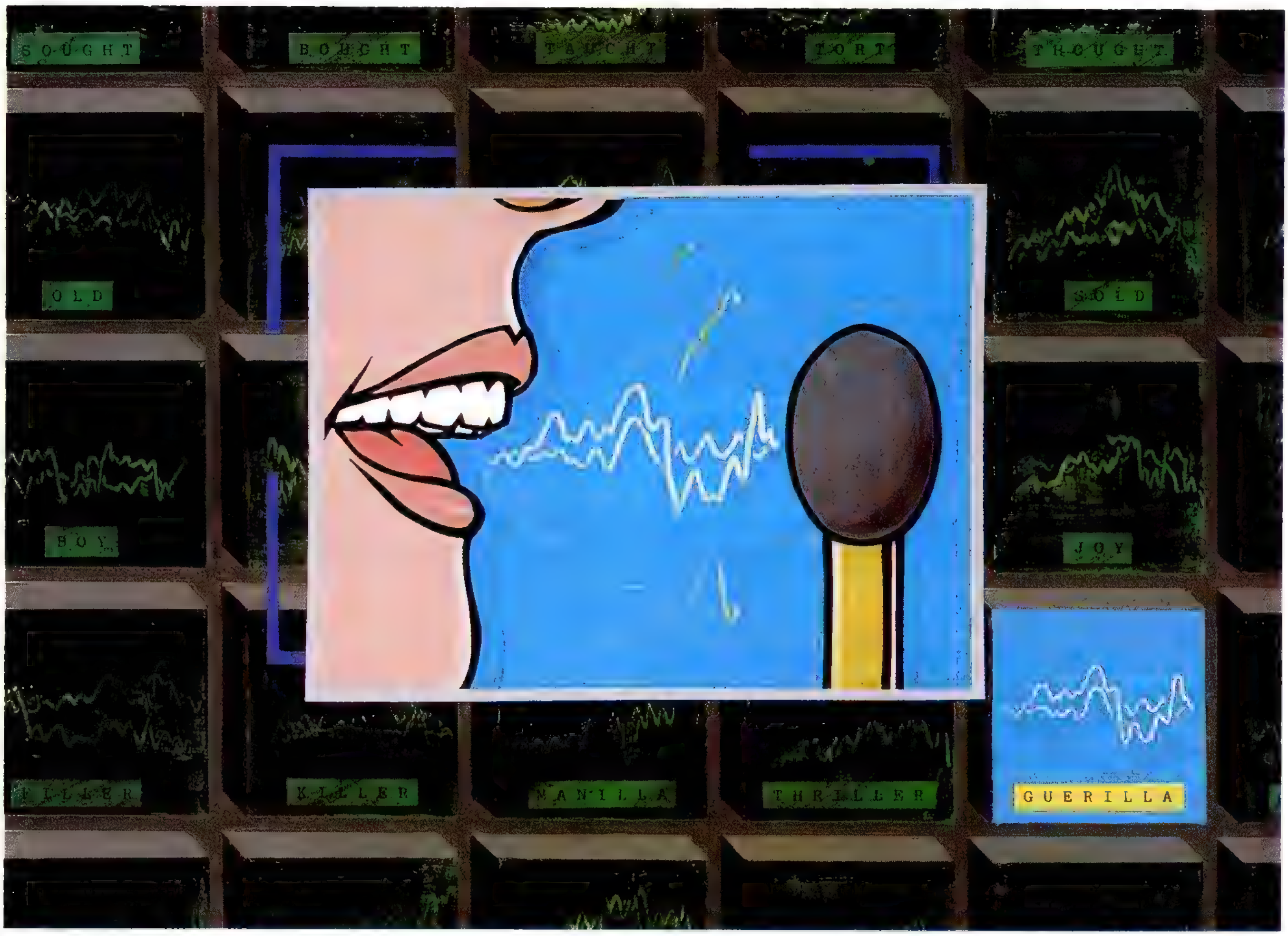
Indeed, natural language speech recognition is one of the main areas of research in the so-called Fifth Generation computer projects initiated by the Japanese Government and more recently by the British Alvey project, the EEC Esprit project and the US Star Wars program.

At present there is no general-purpose, speech-based interface between humans and computers. Nonetheless, a great deal is already known about how to build computer systems which recognise and in a sense 'understand' a limited number of spoken commands. Voice output is far more advanced than recognition and has already found its way into consumer products, from talking motorcars to talking microwave ovens. The technology of voice output is reasonably difficult, but the technology of voice recognition is several orders greater in complexity and shares more with the area of artificial intelligence than traditionalcomputing.

To understand why progress has been so apparently slow, it is necesary to understand just how complex a problem speech recognition is.

What is speech?

Speech conveys information, and the primary task of computer speech processing is the transmission and reception of that information. Superficially speech recognition might seem quite a simple problem. Speech is, after all, just a complex sound wave which can be captured by a microphone, and converted into digital data. This data could



then be analysed to see if the waveform matched any known word, or it could be reconverted to analogue form and output through a speaker to give a synthesised voice output.

However, speech is not as simple as it might seem, for it can simultaneously convey up to three kinds of information (assuming you understand the language), the most important of which is linguistic information. This is the kind of information we generally regard as the meaning of an utterance.

However, at the same time an utterance also provides socio-linguistic information — it tells us something about the speaker's socio-economic group and geographical origin — what we usually refer to as 'accent'.

The final form of information provided by an utterance gives the listener personal information about the speaker — their sex, age, voice quality, emotional state, and so on. It is this information which enables us to recognise people by their voices.

Linguistic information is basically the same as written information except there is no spelling to distinguish between the works or phrases which sound the same.

Consider the following sentence:

'to be or not to be'

In written form this sentence has just one meaning. But if we disregard the constraints of correct grammar for the moment, in spoken form it could have any one of 576 differing permutations of meaning. The word 'to' could be one of 'to', 'too', 'two', or the number 2. Similarly, 'be' could be one of 'be', 'bee' or the letter 'B', and so on.

All these factors add considerably to the complexity of computer-speech recognition. They are also the reasons why computer-generated speech can be very unsatisfactory. Despite the fact that speech can now be synthesised with very acceptable quality, all it conveys is linguistic information. Without emphasis and intonation, it lacks the true quality of human speech which requires all three different types of information.

Building blocks

In nearly all spoken words, the source of power is the lungs pushing air across the vocal chords which are located at the top of the windpipe in the throat. The air passing over the vocal chords causes them to vibrate, as in a musical instrument. This vibration is amplified and modulated by the vocal tract, the tube formed by the windpipe and the cavity of the mouth, throat and nose. By opening and closing various parts of the vocal tract, a process known as articulation, the sound output is changed.

There are basically six types of articulation:

stop — sound stopped by closing the mouth, as in the beginning of 'my' or 'nigh'.

fricative — a turbulent airflow as in the first part of 'fie' or 'thigh' or 'shy'

Dynamic Time Warping

Because speaking rates vary between different utterances of the same word, a dynamic time-warping algorithm is often used to eliminate local timing differences within the word.

After normalisation and scaling, the input data and reference templates are in the form of 12 time frames each with nine coefficients corresponding to one frequency band. In the DTW algorithm a graph is created and the path followed by the line on that graph is used to determine the distance between the two samples.

The first procedure is to place the reference template against the X axis of the graph and the unknown utterance template against the Y axis. Each point along the axis corresponds in fact with a set of coefficient values.

The dynamic time-warping algorithm is used to find the optimal path between coordinates 1,1 and the top right-hand corner, such that the total distance D is minimised.

There are a number of constraints applied to the possible path of the graph to speed up the process and ensure that excessive expansion or compression of the time axis does not occur.

To make it easier to implement the DTW algorithm, the path of the line matching the two templates must start at point 1,1 and end at point 12,12. This 'endpoint' constraint may be different in continuous speech, but will serve for this isolated utterance example.

Additionally, in order to prevent too much time distortion, a local constraint is applied which says that the slope of the graph at any one point can take one of only three values: 1/2, 1 or 2. These slopes are assigned weighting factors W of 2, 1 and 1 determined by how far in the X direction they move.

The combination of these two constraints means that any path must lie within a narrow parallelogram.

The DTW algorithm is concerned with finding, among all the template matches, the one with the shortest global distance between point 1,1 and point 12,12, irrespective of the shape of that path. To add to the complexity, the global distance is not a simple measurement but is the sum of weighted local distances between each point.

An example will better illustrate the method.

Two templates each contain six frames of fine coefficient values. The starting point for the calculation is the first endpoint constraint which is coordinate 1,1. The local 'distance' d(1,1) at that point is the sum of the differences between each pair of coefficients.

In the example

d(1,1) = (13-18)+(25-(-10))+
(-7-(-9))+(-2-8)+(23-23) = 52

Local constraints mean that the next point on the path can only be (2,3), (2,2) or (3,2).

First the local distance at each of these points is calculated by pairing coefficients from the frames that intersect at each of the three points.

The values produced are:

d(2,3)=87
d(2,2)=72
d(3,2)=66

The total distance D at each of these points is the sum of the distance between the templates at point (1,1) plus the distance at each of the three pointsmultiplied by the weighting factor W of the slope needed to get there. Thus:

D(2,3) = D(1,1) + W*d(2,3)
=52 + 1*87 = 139
D(2,2) = D(1,1) + W*d(2,2)
=52 + 1*72 = 124
D(3,2) = D(1,1) + W*d(3,2)
=52 + 2*66 = 184

The smallest of these three values then becomes the new starting point along the optimal path. In this case (2,2) would be the next point. This process is repeated to find the remaining points on the graph, summing weighted values of d(x,y) to give a final global distance D.

This process is performed for each reference template and the one which produces the smallest global distance is deemed to be the best match.

approximant — when one articulation comes close to another, as in the consonants in 'we' or 'you'
trill — vibration of tongue, uvula and lips as in the 'r' in 'rye' or 'ire'
lap — when one articulation touches another as in the middle of 'letter' or 'Betty'
lateral — an incomplete closure on either side of the airstream as at the beginning of 'lull'

The articulations are used to create a set of basic speech sounds known as phonemes. Phonemes are the speech equivalent of the letters of the alphabet used to construct written words. They form a special phonetic alphabet. Phonemes are the basis of many commercial speech synthesisers and voice synthesis programs available for some popular computers since they offer an ideal way of building up the sound of a word without having to store all the data necessary to contain the entire waveform of a single word.

These speech-building blocks are also very valuable in speech recognition. Just as there are rules of spelling for written words, so there are phonetic rules. The recognition and analysis of phonemes, and a knowledge of how they come together, is employed in some of the most sophisticated modern speech- recognition systems.

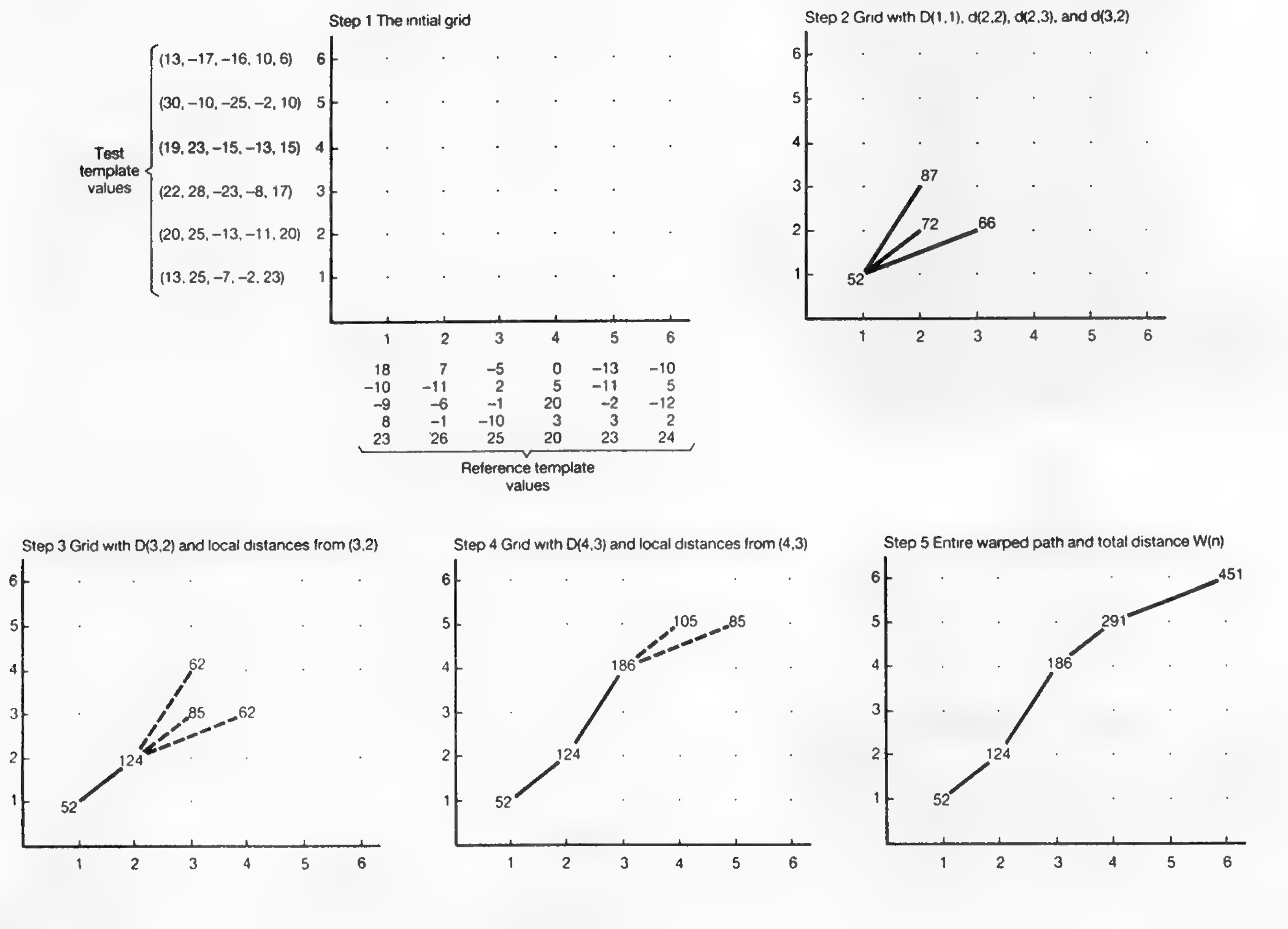
The information contained in speech is very variable — no two people have exactly the same voice, and even the voice of a single individual varies considerably depending on his or her state of health or emotion. In addition, many spoken words are sufficiently ambiguous that they are impossible to recognise out of context. A practical speech recognition must, therefore, not only be able to extract the broad underlying patterns within speech in order to recognise words, but must also be able to understand the context in which the words are spoken.

The reason why engineers have been able to develop recognition systems without the benefit of computer-based artificial intelligence is simply that we can successfully recognise speech in single words and short utterances using pattern-recognition techniques which do not rely on any 'understanding' of what is being said and which do not try to ease their load by predicting which words will come next.

Turning noises into numbers

Sampling speech via a microphone produces a complex electrical waveform. This usually has a repeating pattern and is built up from a number of different frequency signals, each produced by a different part of the vocal tract. These different frequencies vary between 200 and 4000 cycles per second and when produced simultaneously produce a complex waveform.

An analysis of the component frequencies of the speech waveform is the



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SM8502	Modem 3+12® A	MD, PD, MA, OA, SW, ASY, Apple,II/e/c Compatible	300 FDX, 1200/75 FDX (CCITT V.21, V.23, Bell 103)
SM860	AutoModem® 3+12	AD, PD, MA, OA, ASY, AT, SW	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V.21, V.23, Bell 103)
AM100	AutoModem® 21/23	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V.21, V.23, Bell 103)
AM120	AutoModem® 12/12	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX (CCITT V.22, Bell 103, 212A)
AM140	AutoModem® 24/24	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX, 2400 FDX, (CCITT V.22, V.22bis, Bell 103, 212A)
AM160	AutoModem® 123	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX (CCITT V.21, V.23, V.22, Bell 103, 212A)
AM180	AutoModem® 1234	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX, 2400 FDX (CCITT V.21, V.23, V.22, V.22bis, Bell 103, 212A)
SM8911	SmartModem® 21/23SA	AD, PD, TD, AR, AA, OA, AX, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX (CCITT V.21, V.23, Bell 103)
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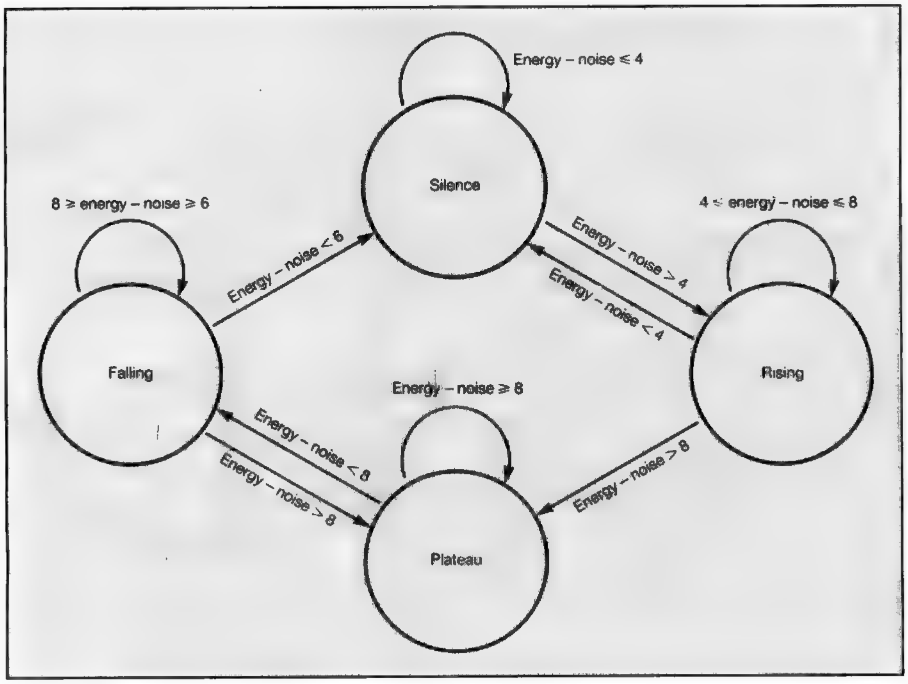

Diagram showing finite state for endpoint detection

basis of most voice-recognition systems currently available. There are several different ways of analysing sound but the simplest involves taking regular samples of the sound and digitising using an analogue to digital converter. A computer can then be used to analyse the digital information into its component frequencies. This mathematical method is known as Fourier analysis.

The problem with using Fourier analysis is that it is a very computationally-intensive and, therefore, too slow for real-time voice-recognition systems. However, the speed of computation can be speeded up by the use of dedicated electronics which decompose the incoming waveform. The earliest of these circuits used a bank of filters, each tuned to allow through only one part of the frequency range of the human voice. By using 14 filters, for example, the voice can be divided into 14 different component frequencies, each with a bandwidth of 250Hz. The information produced can be used to construct a spectrogram of the particular spoken word.

The disadvantage of the Fourier analysis approach is that any background noise will be included within the spectral analysis and, therefore, produce spurious data. One way of overcoming this problem is to use a technique known as Linear Predictive Coding or LPC. LPC is a mathematical process which produces forecasts based on previous events. However, it too is computationally-intensive and is best performed by dedicated hardware. The hardware comprises a filter bank known as an adaptive lattice filter. The output of each filter is dependent on the previous samples and spurious noise will be rejected by the filter system.

By the use of feedback within the LPC filter system, an actual sample is subtracted from its predicted value — the result is a prediction error. The LPC hardware thus separates the components of a signal into those which it can predict and those which it cannot. The LPC can predict speech data because, although speech signals have a complex waveform, they tend to be periodically repetitive and, therefore, predictable. Most external noise, on the other hand, tends to be random. In this way the filter can separate a wanted tone from an unwanted tone such as traffic noise.

The interesting feature of an LPC circuit is that it can act in reverse as a speech synthesiser by applying data obtained during analysis back to the filter bank. This models the articulation of the vocal tract and can generate very high-quality speech output.

Both Fourier analysis and LPC circuits have, over the last two years, been produced as integrated circuits by semiconductor manufacturers for use in simple voice-input systems. Nonetheless, the effectiveness of a speech-recognition system depends on how well the software can interpret the 'clean' data supplied to it by the Fourier and LPC circuits.

Simplifying the data

In order to recognise a given utterance, the software must have a method of matching the data with that of words it has been trained to recognise. The simplest and most common method of doing this is to organise the regularly sampled data as a two-dimensional matrix, with time along one axis and the frequency analysis along the other. This matrix is then compared with reference matrices or templates. The comparison is done using a 'least distance' method which entails computing the sum of the squares of the difference between corresponding elements in the two matrices. The best match will have the smallest distance.

The data may consist of speech samples taken perhaps fifty times a second with each sample consisting of between eight and twelve values corresponding to the frequency bands of the speech waveform. These measurements are collectively known as a 'phone unit'.

The problem with simple matrix-matching techniques is that the duration of a given word varies from utterance to utterance. People do not always speak at the same speed; and even if they did there is no guarantee that the speech system would start its sampling at exactly the same moment each time.

Most simple commercial speech recognition systems, such as those employed in some toys and computer games, make very little attempt to overcome the problems of timing. They rely, instead, on the user repeating an utterance until some form of feedback shows that the utterance has been recognised. By a very careful choice of vocabulary, to ensure the maximum phonemic difference between all words, such systems can successfully recognise about 75 per cent of isolated words spoken. But such repetition of words is clearly impractical for any serious continuous speech recognition system and in these cases an alternative to simple matrix matching is used. This is called Dynamic Programming.

The immediate problem encountered in filling a speech data array is that of determining the beginning and end of the utterance. Most of the time the input circuitry will be sampling non-speech data which is present in the pauses between utterances. This will consist of an assortment of background noises which could include dis-

tant speech. This data needs to be rejected and the process of finding the start and end of an utterance is known as 'end point detection'.

This process involves identifying four different phases of an utterance. These are termed 'Silence', 'Rising', 'Plateau' and 'Falling'. The beginning of an utterance is defined as that sample of speech where there is a transition from Silence to Rising. The end of an utterance is where there is a transition from Falling to Silence. The utterance will, therefore, consist of all the data samples between and including the two endpoint transitions.

The transition between states is based upon the energy level of the input signal, on the assumption that background noise will always have less energy and thus be quieter than the spoken input. Endpoint detection can be thought of as a finite state machine which moves between the states according to certain rules.

Endpoint detection is further refined by the addition of four criteria.

1 Any single data sample can cause only one state transition. The exception is the data which causes the transition from Plateau to Falling. This data can also be used to test for a Falling to Silence transition. If such a transition is made, then that sample is the endpoint.

2 After the transition from Falling to Silence, there must be at least ten continuous samples of Silence data for the endpoint to be detected. If there are less than ten, then it is assumed that the silence is simply a slight pause within a word rather than an inter-word space. In such cases the system is reset to the Plateau state and the Silence data samples are discarded. Endpoint detection continues from the first non-Silence sample found.

3 Any utterance must contain at least four data samples. If there are fewer, the input is considered to be background noise and is discarded.

4 The maximum energy level in any utterance must be at least 15 decibels greater than the average background noise energy level. If it is less the utterance is discarded.

Data will only pass through the finite state machine if all of these criteria have been met.

Having used endpoint detection to input all the data samples which comprise an utterance, the data is passed through the finite state machine a second time to eliminate all samples whose energy levels fall outside a prescribed dynamic range — here taken to be 42 decibels. This is done by replacing the average noise energy level in the machine with a new lower level set at 42 decibels below the highest energy level of the utterance. By removing all samples with an energy level less than 42 decibels below the peak all data for the template will lie within a 42 decibel dynamic range.

A problem of timing

The data emerging from the endpoint detection process could consist of anything between four and two hundred time samples. Even different utterances of the same word will contain different numbers of samples since noone ever speaks at exactly the same speed. To overcome this variability it is necessary to standardise the number of data samples in all utterances. By doing this the algorithm which matches a spoken work to a template will be ably to work with the same number of data elements in each case.

If the input has a larger number of data elements than is standard, a routine

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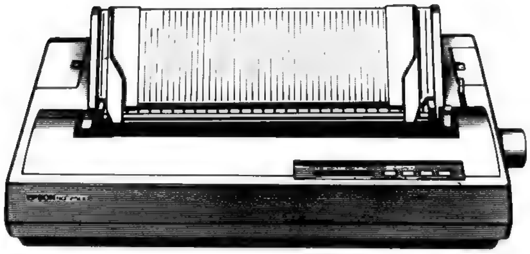

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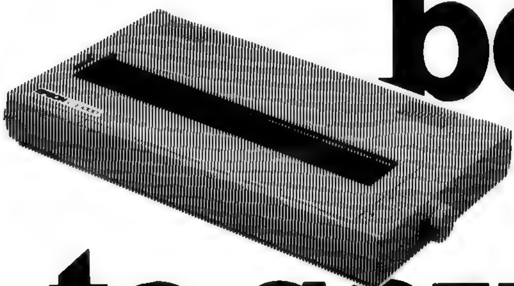

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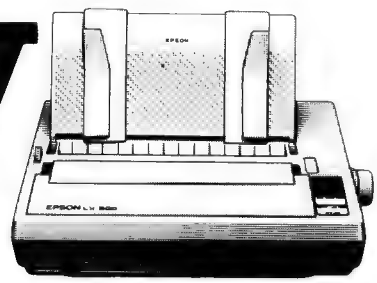

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averages out adjacent elements. Alternatively, if the sample has too few, it will replicate adjacent samples to expand the number of elements.

At this stage we have a standard number of data elements, each of which lies within a 42 decibel range. However, it is also necessary to compensate for variations in the volume with which the speaker said the word. The scaling process modifies the amplitude of the samples so that the peak amplitude is always 30 decibels. This is done arithmetically, and any samples whose amplitude falls below zero are set to zero. The standard number of data elements, which now all have an amplitude in the range of 0 to 30 decibels, are further scaled to fit in a range -40 to +40 decibels.

The data array which emerges from these processes forms the final speech template. This array might typically consist of twelve samples or time frames, with each containing nine parameters or coefficients corresponding to a different waveband.

However, before the system can recognise any speech it has to be trained. Training consists of constructing reference templates which are stored in memory and used during the recognition phase.

A reference template could be created from just one set of input data, but higher recognition scores can be obtained by averaging together two or more templates made from different utterances of the same word. Increasing the number of training passes does not necessarily give a continued improvement in recognition success. A point is eventually reached when too many templates have been averaged together and the coefficients start to converge and lose their meaning.

Improvements in recognition success can be achieved by using multiple templates of the same word generated during different training passes. Such a group of passes is known as a cluster, and the more clusters used the higher the recognition score. However, this will be achieved at the expense of a considerable increase in memory and processor time and a reduction in the number of different words in the template library.

Template matching

The heart of a voice-recognition system is the template matching routine. The normalised data from the utterance is compared with the reference set of templates, each of which is connected with a known word. This superficially simple problem is complicated by the fact that the data contained in the input template will vary slightly for every utterance of the same word.

Not only might the frequency 'shape' of a word be different, but even the same word normalised into the same time frame might have the various syllables spread differently within that time. A speaker might speak quickly at the start of a word on one occasion and slowly the next, yet the whole word might be uttered in the same time.

The variability of fuzziness of the data makes it impractical to use conventional pattern-matching techniques. A conventional algorithm such as 'the sum of the squares of the difference' can be effectively used when reference template words have been selected to be as different as each other, but will fail to reliably identify utterances which are phonemically very similar.

Much of the research into speech recognition has been directed towards finding pattern-matching techniques which can cope with the variability of input data, and one of the most successful of these is known as Dynamic Time Warping.

In implementing the DTW algorithm (see the explanatory box earlier) optimisation of run time is very important. In a practical application, the grid size would typically be 12x12, which means that each template would consist of 12 time frames. Even so, finding the optimal path and the minimum distance for each comparison of utterance and reference template will require a considerable number of calculations. A vocabulary of just 100 words would require 100 calculations in order to find the closest matching word for each utterance. To work in real time and, therefore, match words as quickly as they are spoken, run-time optimisation of what must be assembly code routines is essential.

For larger vocabularies, it becomes necessary to use more powerful processors, and to look towards second-guessing what the next word might be to reduce the search time.

It is at this point that speech recognition moves into the field of artificial intelligence. By attempting to understand what is being said, it is possible to direct searches into subsets of the known vocabulary. This would add considerable speed to the recognition of each utterance.

The use of Dynamic Time Warping has been the basis of most of the advances in speech recognition over the past few years. The power of this algorithm is not just confined to the elimina-

tion of time distortions within the input data. It is also capable of identifying words within continuous speech — a situation where it is impossible to accurately identify the beginning and end of individual words.

Using the DTW algorithm, detection of word boundaries is unnecessary. By simply lengthening the matrix to accommodate an entire sentence, the DTW algorithm can be used to spot individual words within the sentence. By moving a reference matrix for the target word along the sentence matrix, it is possible to look for a significant drop in difference value which signifies the occurrence of the target word.

Despite these many techniques, the computational overhead demanded by real-time voice-recognition is immense. It is estimated that a vocabulary of 5000 words would be needed to cover 95 per cent of the words used in everyday speech.

Current micro-based processors seem capable of handling only around 500 words at a time. Machines handling larger vocabularies have used specialised parallel-processing circuitry.

What's available now?

The range of sub-$1000 commercially-available, voice-recognition devices generally work with vocabularies of up to about 500 words. These are all single-speaker, isolated utterance devices which have, in the main, found their use in hands-off computer applications where the user can interact with the computer via phone or radio link. Such applications range from credit card verification and stocktaking to military command systems.

The more advanced large vocabulary continuous speech devices are largely research projects and not yet commercially available. IBM has developed a 5000-word, voice-input system based on its digital signal processor chips and an IBM AT as a host controller. IBM claims that the system can be trained to recognise a speaker after just 20 minutes and that it will then recognise 98 per cent of the words spoken. IBM is currently trying to expand this device's vocabulary to 20,000 words and to move its accuracy closer to 100 per cent.

The other product capable of handling large vocabularies is the Kurzweil Voicewriter. This is able to handle 10,000 word vocabularies and should come onto the market during 1987 at a price of $US10,000.

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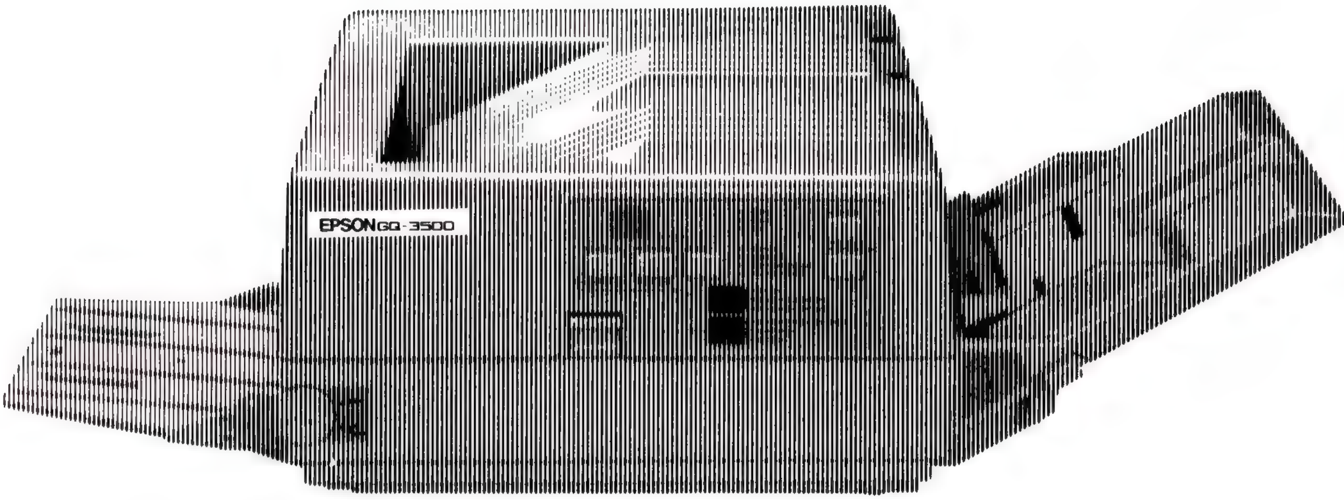

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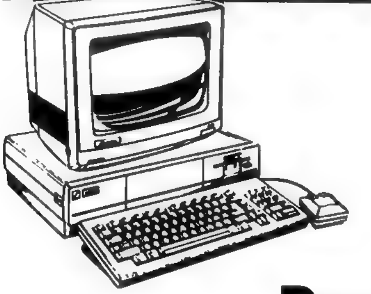

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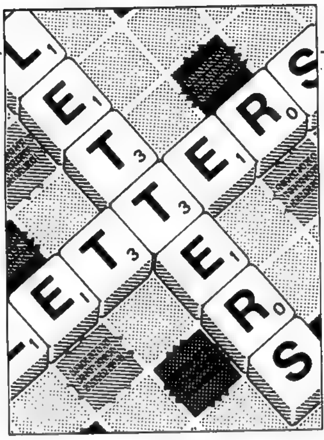

LETTERS

This is your chance to air your views — send your letters or contact us via Microtex on Telecom's Viatel, page 666. The address to write to us is Australian Personal Computer, 124 Castlereagh Street, Sydney 2000.

A real gem

In reply to Guy Kewney's article 'RAMing home the point' I can let you know how to get around the problem of using a RAM disk with GEM on Amstrad's IBM PC-compatible, the PC 1512.

Solution one (rather crude) is to delete the line in the GEM.BAT file which calls NVRPAT2. This is the program which reduces the RAMdrive value to zero in the NVR (non-volatile RAM).

Second solution (more sophisticated) is to alter your CONFIG.SYS file to state whatever RAMdrive parameters you want, rather than calling on the ones set in NVR. This means altering the line which says:

"DRIVER=\MSDOS\ RAMDRIVE.SYS NVR"

to read

"DRIVER=\MSDOS\ RAMDRIVE.SYS 64 128 32"

where 64 means allocate 64k to the RAMdrive, 128 represents the sector size (bytes) and 32 represents the maximum number of root directory entries allowed. Of course, you can alter these figures (within limits) to suit your own circumstances. If you wish to use an extended memory board (LIM standard) you can allocate RAMdrive space in extended memory by adding the parameter /A to the above string.

Obviously you lose the flexibility that the NVR method gives but it does allow you to operate GEM with a RAMdrive.

Incidentally, if you take too much memory for this you will find that not all of the memory-resident utilities will be loaded with GEM (clock, calculator, print-spooler, camera). Be aware that it may also limit your use of PAINT workspace.

Another little hint regarding the Amstrad: many people will be trying to get to grips with Locomotive Basic2 on the new Amstrad PC.

While it is undoubtedly a very comprehensive implementation of the language I have, until recently, considered it to have one problem — it is a long and painful process to load GEM, Basic2 and your own program — then run it. Fine the first couple of times but the whole process becomes boring after a while — and a definite inhibitor to its use.

There is a simpler and very much quicker way — and it is not documented anywhere, as far as I can tell. When calling GEM, add a couple of extra parameters to the command thus:

GEM BASIC2 program

where 'program' denotes the Basic 2 program name (with or without .BAS extension). If 'program' is not in the default subdirectory (which will be \GEMBOOT) then the full pathname should be given, according to the normal rules. So, to run the program DEMO.BAS located in the BASIC2 subdirectory, the command would be:

GEM BASIC2 \ BASIC2 \ DEMO

The specified program will be loaded (with GEM) and run automatically. Control/C stops it as normal and you can edit and save, as you wish. The QUIT option from the files menu (or typed in the dialogue window) does not return you to GEM DESKTOP, as this has not been loaded. It will drop you straight out to DOS again.

This also works for any GEM application — Paint, Doodle, and so on.

Chris Churchouse

Right or wrong?

We would agree almost entirely with Robert Schifreen's review of PC Write (March, *APC*) if the text were in a large bracket prefixed by *NOT*.

We represent entirely different views. I would perhaps be classed as a computer person. As a two finger typist I use PC Write for writing formal documents. I've also used it for program editing.

My secretary does not consider herself a computer person but made friends with PC Write in an hour or so and as a skilled typist has used it for an extraordinary range of output since. We have looked at other WP packages over the last few years but we have not seen sufficient advantages to woo us away from PC Write.

J Underwood

Craving for a Cray

I'd really like to see a series of articles on supercomputers, especially the Cray II. I know they are not really business machines, but I'm sure that many readers would like to buy one. And it would be interesting to see what's at the very pinnacle of computing and how far micros have to go to catch up.

I think your covers are usually brilliant, though a bit similar in their execution. But then, maybe in ten years' time we'll see animated covers.

John Trippick

As the Cray II seems, on a preliminary glance, to be the computer the majority of our readers would like to own, we are already investigating a special offer of one at half price for each reader.

Zipsort bludner

With regard to my program ZIPSORT 128 which you were kind enough to publish in June's Program File, I've noticed that line 1133 has appeared incorrectly. I have checked my file copy of the program, and I think that the problem has arisen from the fact that you have not seen the original listing I provided. Somebody at Microtex has obviously run another listing using a C64, with the result that the only C128-specific keyword I used in the program has been corrupted.

Line 1133 should read:

```
PRINT#2,CHR$(DEC(HX$));
```

Most experienced users will probably spot the error and know what to do about it, but I have some concern for others who may want to use the program and will be cursing me when it hangs up.

Kevin Riordan

Barson's bug

I write regardiing recent press reports concerning a bug in Apricot PC's BIOS affecting the calendar.

The bug, which appeared some time in March, seems to add a month and 10 days to the internal calendar yet leaves the LCD calendar, on the microscreen with the cor-

rect date — quite annoying if one automatically date-stamps files or has an input date comparison utility.

This bug which is in fact a machine defect will be fixed by Barson Computers, the Australian distributor for Apricot. The problem is that the company demands a $25 'handling charge'. Excuse me for thinking that this is a way of pretending that the fix is free. I should point out that the fix involves a BIOS upgrade being copied onto my disk. We all know how long it takes to format and then copy a floppy disk . . . three minutes at the most. The handling fees therefore work out to $500 per hour. I wonder if IBM is charging Westpac a 'handling charge' to fix the bug that caused so much money to be given away from ATM's in June.

All this makes it seem that distributors are becoming more like the dealers who push boxes out the door: take the money and forget the customer.

The matter is now in the hands of the Trade Practices Commission who have informed me that legally they must fix the bug for free.

I request that you pass this information on to your readers who use Apricot PCs so that they may take a stand on having a faulty product repaired or even getting a refund if Barson has been found to breach the Trade Practices Act.

Steve Davis
I'll Do Anything For Money Pty Ltd

Which Word?

I am writing to complain about your review of Microsoft Word for the Macintosh. First, given that you very sensibly review both Macintosh and other materials, it would help if you could indicate in the title of an article which computer the program is intended for when they have the same name. As you know, there is a Microsoft Word 3.0 for the IBM family. However, the real problem is that you didn't review Word 3.0 at all. You were apparently taken-in by Microsoft which has been selling Word 3.0 everywhere, and appears to have been sending reviewers some debugged version 3.2, as your reviewer mentioned at the end of the article.

3.0 is a shocking mess; it should never have been released in this form. But it seriously impairs the credibility of reviewers (and

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LETTERS

magazines) to review a product that has quite a different release number from the one they say they're reviewing.

3.0 crashes, performs inconsistently, doesn't do what its manual says it will do, and in general is going to cause nightmares in 10,000 offices.

The Perth Microsoft support office says that 3.0 should not be run even on the System and Finder that come with the new SE. They are not late enough! It requires the System and Finder for Appleshare. Not that it's bug free at that point, but it's a little better. Of course Microsoft should have immediately stuck labels on every copy as soon as these bugs turned up (which was months ago or else they'd hardly be on the point of making a new release).

In any case, those of us who buy the products with our own money are not going to easily forgive Microsoft for this; and we'd like to think that you're on our side too, and will in fact review the products that are in the shops.

Michael Scriven
Department of Education
University of Western Australia

The introduction to the article in question clearly states that the version of Word being reviewed was for Apple's machine. On the subject of 'Version 3.2', Microsoft has been given the right of reply:

"Firstly, let me assure you, we have never sent any unique or special version of products for review to any publication. If a product for review is sourced from Microsoft it is either a 'beta' (pre-release) version, or a finished and released product. That is it; there is no special 'journalist' version of our products.

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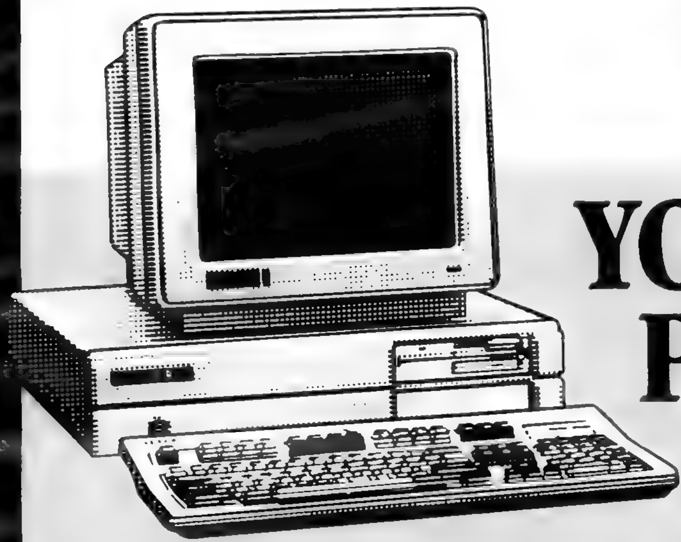

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Secondly, specifically regarding Microsoft Word for the Apple Macintosh Version 3.0, it is not a shocking mess. We are complimented frequently by our customers (and reviewers!) on its usability, features, and documentation. It is a superb product.

Word is not, however, without some problems; all software has some problems, Word 3.0 for Macintosh included. Some problems are: intermittently adding gaps between paragraphs, and problems with using Apple system software with the inappropriate Macintosh. We ship the correct System and Finder for a minimal Macintosh configuration — a Mac 512k with 800k drives. We feel it is an issue for the user and his dealer to be sure the customer has the correct System software for his Macintosh. Each of our products, Word 3.0 for the Macintosh being no exception, is enhanced and improved on a regular basis. Each registered user of Word 3.0 for the Macintosh will receive a courtesy upgrade to Version 3.01. This is a maintenance upgrade to fix known problems. Word 3.01 will ship in July, 1987.

I assume Mr Scriven is receiving his support from the University Consortium where he purchased his product. We do have a knowledgeable distributor in Perth (MicroSL), and it exists primarily to service the Microsoft dealers in Western Australia, not to support end users.

Microsoft is making every effort to support its customers with the best software supplied in a timely fashion. We are concerned that Mr Scriven felt compelled to write to you. We hope the forgoing will set the record straight."

Phil Jones
Microsoft Pty Ltd

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Working to rule

Expert systems depend on their database of rules. Jack Weber shows how a spreadsheet such as Excel can be used to store this core of data.

Expert systems have been one of the most talked-about applications of computing in the past few years. Their origin in artificial intelligence, their retinue of knowledge engineers and their promise of the dawning fifth generation have given expert systems a glamour that is somewhat belied by the few real applications that exist, many in resolutely unglamorous areas like air conditioning maintenance. Nonetheless, these knowledge-based systems have brought many important and valuable computing techniques into use; one of which is a process called rule induction.

The core of any expert system is its database of rules. These codify the knowledge contained in the system in the form of multiple IF . . . THEN . . . statements. Deriving these rules is the most time-consuming part of creating an expert system. Rule induction automates the process by using the computer to extract general conclusions from a list of specific examples. For instance, I may not know the difference between butterflies and moths but, given a large enough number of correctly identified specimens, I should be able to discover that both have four wings but that only the butterflies have clubbed antennae. Rule induction would establish this fact and create a rule along the lines of 'If antenna shape is clubbed then specimen is butterfly.' Since wing number does not help in the identification, it would be automatically excluded.

Like any attempt to argue from the particular to the general, rule induction is fraught with dangers. Most importantly, its usefulness is very dependent on the selection of examples. But used intelligently, rule induction can have many applications, and not just for creating expert systems. For example, it can be usefully employed in business to analyse pricing policy in a particular market or used to check the validity of one's assumptions about a subject.

Various techniques have been developed for rule induction; the program described here is based on a method called the CLS (Concept Learning System) algorithm. One form of CLS, known as ID3 (Interactive Dichotomiser 3), has been the basis for several successful commercial programs such as Expert-Ease. Although not quite as sophisticated as the commercial packages, this program is perfectly usable for serious applications and the result is presented in a form that should be fairly easy to adapt to many expert system shells.

	A	B	C	D	E	F
1	Attributes	RAM	HD SPEED	DISPLAY	CPU	PRICE
2	Values that	512	fast	EGA	8	4400
3	may be used	640	slow	Hercules	10	4700
4	(up to ten)	1000	#N/A	MDA	#N/A	5000
5	:	#N/A	#N/A	#N/A	#N/A	#N/A
6	:	#N/A	#N/A	#N/A	#N/A	#N/A
7	:	#N/A	#N/A	#N/A	#N/A	#N/A
8	:	#N/A	#N/A	#N/A	#N/A	#N/A
9	:	#N/A	#N/A	#N/A	#N/A	#N/A
10	:	#N/A	#N/A	#N/A	#N/A	#N/A
11	:	#N/A	#N/A	#N/A	#N/A	#N/A
12	No. of values					
13	Examples	512	slow	Hercules	8	4700
14	:	1000	slow	Hercules	8	4700
15	:	512	slow	EGA	8	5000
16	:	512	slow	Hercules	10	4400
17	:	1000	slow	Hercules	10	4700
18	:	512	slow	EGA	10	5000
19	:	640	fast	EGA	8	5000
20	:	1000	fast	EGA	8	5000
21	:	512	slow	MDA	8	4700
22	:	1000	slow	MDA	8	4700
23	:	512	fast	MDA	8	5000
24	:	512	slow	EGA	8	5000
25	:	1000	fast	MDA	8	5000

Data set for IBM AT compatibles

Choice of language

When approaching a programming task, it is natural to think of the language one knows best. Certainly there is no reason why common languages like Basic or Pascal should not be

used for a rule induction program, but would they be the best choice? Professional knowledge-base programs are often written in Lisp or Prolog, which are well-suited to the task but are not widely used outside the academic community. The nature of rule induction suggests another alternative.

I shall be dealing with a database of examples, and many of the operations required are the typical database ones like sorting, deleting, comparing and extracting data according to certain criteria. Normal mathematical and control functions are also needed, plus the ability to employ physical layout to make the rule's meaning clearer. The obvious choice seemed to be a programmable spreadsheet.

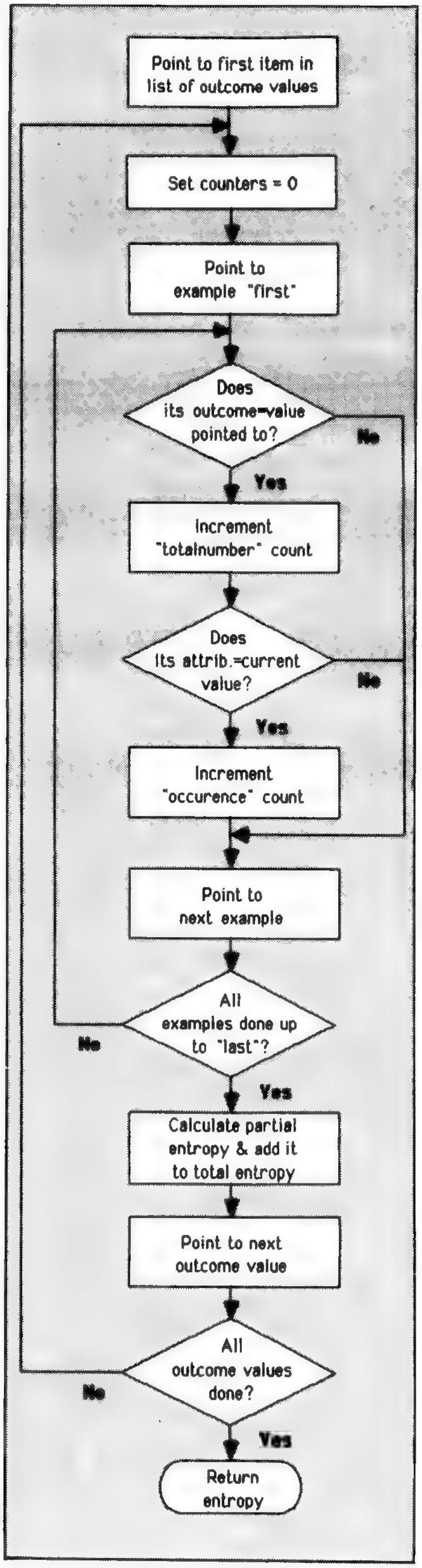
All too often, spreadsheets are treated as if they were only fit for accountancy and financial forecasting. Even the simplest spreadsheet is a limited form of language, while the more sophisticated ones are powerful and versatile programming languages in their own right. Their control structures tend to be limited, but they do offer many advanced functions that would take a great deal of coding in other languages.

The program (which is given in 'Program File') is written for Microsoft Excel (only available on the Apple Macintosh) but it should be possible to transfer the approach to other macro-programmable spreadsheets and databases. The underlying algorithm could, of course, be implemented in any language on any machine.

The rule induction algorithm

First, a few terms need to be defined. For the subject in hand we select a number of attributes (for example, size) which can take on a pre-defined range of values (for example, small, medium, large). We also select an outcome with its own range of values — our aim is to find out how examples with different combinations of attribute values allow us to predict the outcome.

The table opposite shows how different values combine in reality. From these specific examples, the program must induce a general rule which will tell us what outcome to expect for any combination of attribute values. The table shows some features of various makes of low-end IBM AT compatibles. The chosen outcome is price (+/—$4500) and we want to see how the price is determined by display type, CPU speed (MHz), hard-disk speed and RAM size (k).



Flowchart for function macro 'Entropies': calculates entropy of a given attribute value using examples 'first' to 'last'

It is important to appreciate that we will not be creating any new information. Everything that we can hope to obtain is already in the list of examples; all that we are trying to achieve is brevity. For instance, it is evident from the example table that all the models containing an EGA display fall into the $5000 bracket regardless of which other features are present. Rule induction could reduce all these examples to one line: 'If display = EGA then price = 5000'. MDA and Hercules displays, on the other hand, need to be further sub-divided according to other attributes, so they will lead to a more complex branching in the rule.

However, display type may not be the best attribute to begin with; perhaps starting with hard-disk speed would lead to a simpler rule. It is often not obvious what to do, and creating the most efficient rule requires that we should select very carefully the order in which we take the attributes and their values.

This sorting and ordering of attributes and values is the main task of the rule induction algorithm. It is achieved by the repeated use of a mathematical concept borrowed from communication theory — entropy.

Entropy originally arose in the study of thermodynamics but it has since been applied to many other areas. It is a difficult notion to capture without the use of mathematics, but a worthwhile and often-used analogy is to think of it as a measure of disorder or randomness. Suppose that you are sending data down a telephone line. If the circuit were perfect, you could predict that what is received will be exactly the same as the message sent. In practice, interference and degradation of the signal will result in some of the information being corrupted. The result is, therefore, somewhat unpredictable but not totally random; entropy provides a way of measuring this uncertainty.

In the context of rule induction, we are also interested in a form of prediction. Going back to the computer example, the presence of an EGA display turns out to be a perfect predictor of price (that is, it has zero entropy) but what about the Hercules card? Three out of four examples have the same price, which suggests that there is some predictive value but that it is not perfect. Entropy allows us to quantify and compare these predictive powers precisely. Just as individual values have an entropy, so do complete attribute columns. Is display type a better predictor than RAM size? Using entropy we can decide.

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10-99 DISKS	100+DISKS	1,000+DISKS
$42.50 (PER 10 DISKS)	$39.95 (PER 10 DISKS)	$35.00 (PER 10 DISKS)

(SEND $5 FOR SAMPLE DISK!)
(TAX EXEMPT PRICES LESS 40¢ PER DISK)

VERBATIM 5¼" HIGH DENSITY DISKS!

Rod Irving Electronics have made an unbelievable price break through on High Density Verbatim disks! And you're the one who benefits!

1-9 BOXES	10+BOXES	100+BOXES
$59.95 (PER 10 DISKS)	$49.95 (PER 10 DISKS)	$47.50 (PER 10 DISKS)

VERBATIM 20 M/BYTE HARD CARD $1,195

IBM* XT COMPATIBLE COMPUTERS from $795*

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Assembled in Australia!
- Tested by us for 24 hours prior to delivery!
- 150W power supply
- AT style keyboard
- Operating manual
- 8 Slot motherboard
- 6 Months warranty!

(Japanese drives available for an extra $50 each)
(4.77/8MHz Turbo Motherboard with Soft/Hard switch, available for an extra $50)

*$795 COMPATIBLE COMPUTER

256K RAM Single Drive, Graphics and Disk Controller Card $795

256K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card,(which has Disk Controller, Clock/Calender including Timer disk, 2 Serial Ports, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card. $1,095

640K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card,(which has Disk Controller, Clock/Calender including Timer disk, 2 Serial Ports, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card. ..... only $1,150

20 M/BYTE HARD DISK COMPATIBLE COMPUTER

20 M/Byte Hard Disk, 360K Disk Drive(s), 640K RAM, Multifunction Card, (which has Disk Controller, Clock/Calender including Timer disk, 2 Serial Ports, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card.
Single 360K Floppy Disk Drive .... only $1,850
Dual 360K Floppy Disk Drives .... only $1,995

IBM* AT COMPATIBLE only $2,975

ASSEMBLED & TESTED IN AUSTRALIA!

- 1 M/Byte Main Board
- 1.2 M/Byte Floppy Disk Drive
- Colour Graphics Display Card
- Floppy & Hard Disk Controller Card
- Printer Card and RS232
- 200W Power Supply
- 6 Months Warranty
- 6 MHz
- 80286 CPU
- 8 Slots
- 20 M/Byte Hard Disk
- Keyboard
- Manual

.... only $2,975

RETAIL INQUIRIES: Rod Irving Electronics,
MELBOURNE, 48 A'Beckett St. Phone (03) 663 6151
NORTHCOTE 425 High St. Phone (03) 489 8866
MAIL ORDER: (03) 543 7877 or P.O. Box 620, CLAYTON 3168

WHOLESALE INQUIRIES: Ritronics Wholesale, 56 Renver Rd. CLAYTON 3168. Phone (03) 543 2166

Errors and omissions excepted
*Apple and IBM are registered trade names

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!!

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!!

VERBATIM DISK SPECIALS!

All prices 10 disk boxes!

Description	1-9 boxes	10+boxes
5¼" S/S D/D	$27.95	$26.95
5¼" D/S D/D	$34.95	$32.95
5¼" D/S 80 track	$75.00	$70.00
5¼" High Density	$59.95	$49.95
3½" S/S D/D	$54.95	$49.95
3½" D/S D/D	$59.95	$55.95

RS232 INLINE SWITCHING BOX

- 25 pin "D" plug to 25 pin "D" socket
- DIP switches allow easy switching of internal wiring

Cat X15662 $32.95

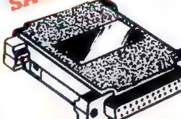
CENTRONICS GENDER CHANGERS

- Female to Female
- Saves modifying or replacing non-mating Centronics cables
- All 36 pins wired straight through

Cat X15663 **Male to Male**
Cat X15661 **Male to Female**
Cat X15664 **Female to Female**

Normally $33.95
Only $24.95

SAVE $5



RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat X15650 **Male to Male**
Cat X15651 **Male to Female**
Cat X15652 **Female to Female**

Normally $19.95 each
Only $14.95

SAVE $6

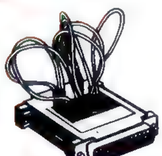
RS232 MINI JUMPER PATCH BOXES

- Interface RS232 devices
- 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

Cat X15653 **Male to Male**
Cat X15654 **Female to Male**
Cat X15655 **Female to Female**

Normally $25.95
Only $19.95

SAVE $8



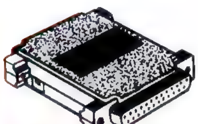
RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat X15665 ..... **Normally $49.95**
Only $44.95

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

SAVE $7

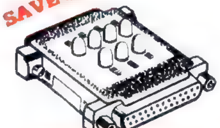


RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat. X15657 **Male to Male**
Cat. X15658 **Male to Female**
Cat. X15659 **Female to Female**

Normally $22.95
Only $14.95

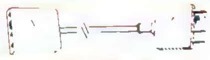


RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

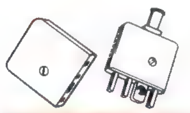
T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 ...... **Normally $39.95**
Only $29.95



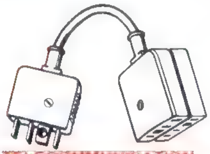
TELECOMMUNICATION EXTENSION LEADS

Cat Y16010 5 metre ... $12.50
Cat Y16012 10 metre ... $14.95



TELECOMMUNICATION PLUG/SOCKET

Plug Cat Y16016 $3.95
Socket Cat Y16018 $4.95



TELECOMMUNICATION PLUG TO 2 SOCKETS.

Ideal for modem connections
Cat. Y16014 .... $12.95

TELECOMMUNICATIONS AUSTRALIAN TO U.S. ADAPTOR CABLE

- Australian socket to U.S plug
- Length 5 metres

Cat Y16017 $7.95

TELEPHONE ADAPTOR

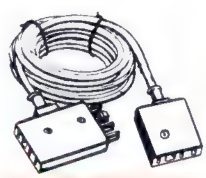
- Australian plug to U.S socket
- Length 10cm

Cat Y16026 .. .. $5.95

TELEPHONE CURL CORD

- U.S plug to U.S plug
- Replacement hand set cord
- Length 4.5 metres

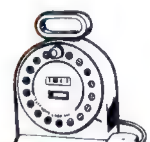
Cat. Y16023 .... $6.95



TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE

- Australian socket to plug/socket
- Length 10 metres

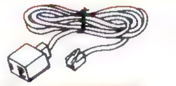
Cat Y16015 .... $14.95



TELEPHONE EXTENSION CABLE UNIT

Allows 15 metres of telephone extension cable to be neatly wound into a protable storage container. The reel sits on a flat base and has a handle to wind cable back on to it after use. No tangles - no mess! Ideal for the workshop, around the house, office, pool etc

Cat Y16013 $22.95



U.S. TELEPHONE EXTENSION CABLE

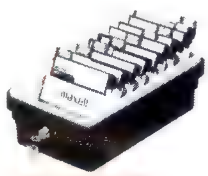
- U.S. plug to U.S. socket
- Length 10 metres

Cat. Y16024 .... $7.95

U.S. TELEPHONE EXTENSION CABLE

- U.S. plug to 2 U.S. sockets
- Length 10 metres

Cat. Y16028 $9.95



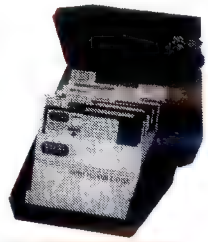
JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...

- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

C16020 .... **only $24.95**
C16027 (Hinged Lid) .. **$26.95**



5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...

- 70 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat C16025 .... **only $19.95**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base
- Anti static

Cat C16040 **only $19.95**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base

Cat. C16035 .... **only $19.95**

2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

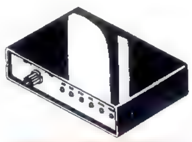
2 WAY Cat X19120 ~~$125~~ **$95**
4 WAY Cat X19125 ~~$145~~ **$119**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics Star, and many other printer manufacturers

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY Cat X19130 ~~$125~~ **$95**
4 WAY Cat.X19135 ~~$145~~ **$119**



RS232 DATA SWITCH WITH TESTER

- No power required
- Ideal for 1 computer to 2 peripherals or 2 computers to one peripheral
- 25 pin RS232 "D" connectors.
- Six dual coloured LED indicators showing certain flow status

T.D. Transmit Data
R.D. Receive Data
R.T.S. Request To Send
C.T.S. Slear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready

- Size 200(W) x 68(H) x 150(D)mm

Cat.X19110 .... **R.R.P. $169**
Our Price $149

SAVE

SEMICONDUCTORS!

Always check our prices before you buy!

	1-9	10+	100+
2716	$9.95	$9.50	$8.95
2732	$8.95	$8.50	$7.95
2764	$7.95	$7.50	$6.95
27128	$6.95	$6.50	$6.25
27256	$11.50	$10.50	$10.00
27512	$19.50	$18.50	$17.50
4116	$3.95	$3.50	$2.95
4164	$2.25	$1.95	$1.75
41256	$6.95	$6.50	$5.95
555 8pin	$0.50	$0.40	$0.35
6116	$3.95	$3.75	$3.50
6264	$6.50	$6.00	$5.75
6802	$5.00	$4.00	$3.75
6821	$2.00	$1.80	$1.70
6845	$5.00	$4.00	$3.75
7406	$0.40	$0.30	$0.25
INS8250	$29.95	$27.95	

NE5534AN

SCOOP PURCHASE!!!

1-9	10+	100+
$1.95	$1.85	$1.75

WORLD MODEM CHIP

Cat. U21614 .... Normally $49.50
Save $25, SPECIAL $24.95

MEL9501

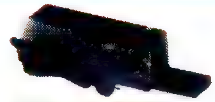
Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing boards? We have the MEL9501 chip!

SPECIAL, ONLY $29.95

8087

Genuine Intel chips with manual and data sheets packed in boxes!

8087-3 (4.77MHz) **$269**
8087-2 (8MHz) **$385**
8087-1 (10MHz) **$585**
80287-3 (6MHz) **$475**
80287-7 (8MHz) **$679**



UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips)

Features include

- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

WITHOUT TIMER

Cat X14950 .... **Normally $119**
Special, $89

WITH BUILT-IN TIMER

Cat. X14955 .... $139
Special, $119

SAVE

"IBM* AT COMPATIBLE" KEYBOARD

- 100% IBM* PC, XT compatible
- Low profile keyboard design
- Proper placement of shift keys with large key tops to suit professional typists
- 3 step height/angle adjustment
- Cherry brand TS-M00001 19mm low profile switches, meet 30mm ergonomic requirement and provides high performance and maximum reliability
- Curl lead plugs straight into PC/XT
- 3 Status displays

Just like the "Real McCoy" only at a fraction of the price!

Cat.X12020 .. **only $129**

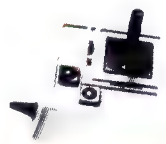
SAVE $100

IBM* XT & AT COMPATIBLE EXTENDED KEYBOARD (105 KEYS)

These new keyboards are both XT and AT compatible!

- 20 Dedicated function keys
- Enlarged "Return" and "Shift" key
- Positive feel keys
- Low Profile Design, DIN standard
- Separate Numeric and Cursor control keypads
- Additional Functions: Key-in-lock, Audio Beep, Previous Word, Next Work, Fast Repeat, Line Feed, Pause, Clear Screen, Reset

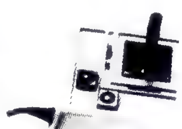
Cat.X12022 **WAS $299**
SPECIAL, ONLY $199



APPLE* II SERIES COMPATIBLE JOYSTICK

These joysticks have adaptor connectors to suit the Apple II, IIc, IIe and II+ computers. Features include selectable "spring centring" or "free floating". Electrical trim adjustments on both axis, 360° cursor control and dual fire buttons

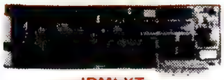
Cat C14201 .... **$49.95**



JOYSTICK FOR IBM

Features Selectable "Spring centering" or "free floating". Electrical trim adjustments on both axis 360 degree cursor control

Cat. C14205 **$49.95**



IBM* XT COMPATIBLE CARDS

NEW! NEW! NEW! NEW!

20M/BYTE HARD DISK CARD
XT compatible, simply plugs straight in to your computer!
Cat. $1,195

Colour Graphics Card
Cat X18002 .... $129

Graphics Card (Hercules compatible)
Cat. X18003 .... $145

Floppy Disk Drive Controller Card (2 Drives, 16 Bit)
Cat. X18005 .... $59

Floppy Disk Drive Controller Card (4 Drives, 16 Bit)
Cat. X18006 .... $65

High Resolution Mono Card
Cat. X18007 .... $199

Colour Graphics & Printer Card
Cat. X18010 .... $149

768kB RAM Card (without memory)
Cat. X18012 .... $89

Printer Card
Cat. X18017 .... $34.95

Game I/O Card
Cat. X18019 .... $37.95

XT Motherboard (without memory)
Cat X18020 .... $225

Clock Card
Cat. X18024 .... $57.50

RS232 Card (without cable)
Cat. X18026 .... $52.50

RS232 & Clock Card
Cat. X18028 .... $95

XT Turbo Motherboard (without memory)
Cat. X18030 .... $275

Multi I/O & Disk Controller Card
Cat. X18040 .... $169

I/O Plus Card
Cat. X18045 .... $129

768K Multifunction I/O Card (includes cable but not 41256 RAM)
Cat. X18050 .... $199

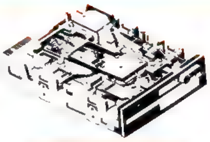
Hard Disk Controller Card
Cat X18060 .... $195

Enhanced Graphics Adaptor Card 256K RAM on board
Cat. X18070 .... $295

64K Printer Buffer Card
Cat. X180?? $139

(AT COMPATIBLE)

Enhanced Graphics Adaptor Card (Award Bios)
Cat. X $495



NEC DISK DRIVES

3½" DISK DRIVE
- 1 M/Byte unformatted, (640K formatted),
- Double sided, double density,
- Access Time 3m/sec

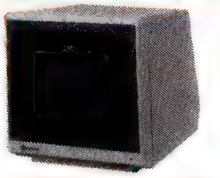
Cat. $265

5¼" SLIMLINE
- Switchable 1.6 M/Byte to 1 M/Byte unformatted 1.2 M/Byte to 720K formatted
- Double sided, double density,
- AT compatible

Cat. C11906 .... $295

8" SLIMLINE
- Double sided, double density,
- 1.6 M/Byte unformatted.

Cat. C11908 .... $795



SAMSUNG TTL MONITOR

A quality 12" TTL monitor, with a high contrast, non-glare screen at a very reasonable price!

SPECIFICATIONS:
CRT: 12" diagonal 90° deflection, non-glare screen.
Active Display Area: 216(H) x 160(V)mm
Display Characters: 2,000 (80 characters x 25 lines)
Scanning Frequency:
Horizontal: 18 432 + − 0.1KHz
Vertical: 50 HZ + − 0.5%

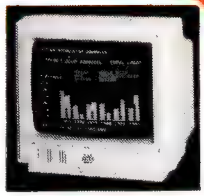
Description	Cat.No.	1-9	10+
Green	X14517	$189	$179
Amber	X14518	$189	$179

SAKATA 13" RGB COLOUR MONITOR

High quality IBM* compatible monitors, great with VCR's too!

SPECIFICATIONS:
CRT: 13", 90° deflection colour
Input Signal:
Video Signal. Separate video signal
Video: Positive
Sync.: Positive
Input Level: TTL Level
Scanning Frequency:
Horizontal: 15.7KHz
Vertical: 60Hz
Display Size: 245(H) x 182(V)mm
Resolution:
Horizontal: 640 dots
Vertical: 200 lines

Cat. X14530 .... $695



INTRA 14" RGB HIGH RESOLUTION COLOUR MONITOR

Compatible with IBM* and compatibles, and EGA Cards.
Why pay more?
Resolution: 640 x 350 dots
Dot pitch: .31mm
Display Format: 80 x 25 characters

Cat. X14514 ...... **Normally $1,295**
Our price $995

INTRA 14" RGB COLOUR MONITOR

Resolution: 640 x 200 dots
Display Format: 80 x 25 characters
Display Colours: 16
Dot pitch: .39mm
Sync Horiz. Scan Freq: 15.75 KHz
Sync Vert. Scan Freq: 50Hz
Band Width: 18MHz

Cat. X14520 .... $695

RITRON 2 MONITORS

Stylish 20MHz, non-glare 12 inch monitors available in green or amber displays and featuring swivel base that tilts forward and back and swivels right to left!

Green Cat X14506. **Normally $235**
Amber Cat.X14508 **Normally $239**
SPECIAL, ONLY $199

ROD IRVING ELECTRONICS FOR ONE STOP BARGAIN SHOPPING!

SENDATA DIRECT CONNECT MODEM

- CCITT V21 300 baud full duplex
- CCITT V23 1200/75
- Bell 103 300 Full duplex
- Bell 202 1200 Half duplex
- Auto answer, auto disconnect
- LED display for Power, TX, RX, CD
- AC power adaptor included
- DB25 pin connector
- Telecom Approval N° C83/37/1045

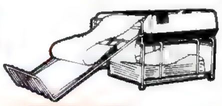
Cat. X19120 .... $295
(SOFTWARE FOR VIATEL $95)

1 YEAR WARRANTY!

IBM* COMPATIBLE DISK DRIVES

Tired of paying out more for Japanese Disk Drives? These "direct import" Hong Kong disk drives are the solution! They feature Japanese mechanical components, yet cost only a fraction of the price!

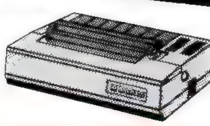
Cat.No.	Description	Price
C11801	500K	Normally $199
		SPECIAL, ONLY $179
C11805	1.6 M/Byte	$259



PAPER TAMER

- Restores order to the top of your desk or work area
- Made of white plastic coated steel
- Stores up to 900 continuous sheets
- Allows perfect paper feed
- Allows easy examination of print out

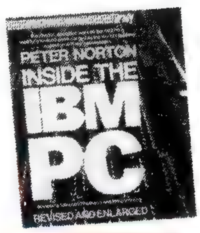
C21050 (10") ..... **only $49.95**
C21050 (15") ..... **only $79.95**
(Printer and paper not included)



CANON A-40 PRINTER

- Serial Impact Dot Matrix
- 140 C P S
- Near Letter Quality Mode
- 1 4K Buffer

Cat. C20040 .... $595



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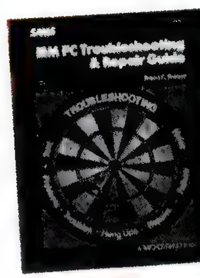

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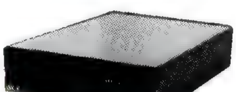

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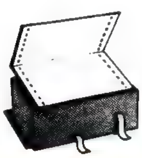

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Calculating entropy

One simple formula is central to the whole program — it calculates the entropy associated with a particular attribute value. Entropy is a logarithmic function, and it is usual in communications and information theory to use logs to base 2. Like most other programming languages, Excel does not offer base 2 logs as a built-in function but they can be easily calculated using:

$Log_2(N)=log_{10}(N)/log_{10}(2)$.

The other element of the calculation is probability; in particular, the likelihood of getting a specific outcome value, given a certain attribute value. In the case of the Hercules display, out of four examples, we get 4400 once, 4700 three times and 5000 not at all; so the probabilities of these outcomes are 0.25, 0.75 and 0 respectively. For each outcome value we must multiply the probability by its logarithm, then sum up all the results like this:

$Entropy(Hercules) = -(0.25 \times log_2(0.25) + 0.75 \times log_2(0.75) + 0 \times log_2(0))$

The minus sign is needed because logs of fractions come out negative and it makes more sense to have a positive answer. Note also that log(0) is an undefined number, but that whenever it crops up it is always multiplied by zero and so can be ignored.

Having obtained all the attribute value entropies, we can compare complete attribute columns by calculating an overall entropy for each. A simple sum of its value entropies would not do because the most common values should contribute more than the rare ones. It would be much better to multiply each value entropy by the probability of finding that value. Out of 14 examples, six have EGA, four Hercules and four MDA. The orresponding entropies are 0, 0.8113 and 1, so the overall entropy of the Display attribute is:

$Entropy(Display) = 0 \times (6/14) + 0.8113(4/14) + 1 \times (4/14)$

Doing the same for all the attributes, the results come out to: RAM (1.1180), Hard Disk Speed (0.9721), Display (0.5175), CPU Speed (1.1221); so Display is the one to start with.

It is important to note that entropies are not absolute, fixed quantities — in fact

	A	B	C	D	E	F	G	H	I	J	K
1	Attributes	Attr. 1	Attr. 2	Attr. 3	Attr. 4	Outcome					
2	Permitted	#N/A	#N/A	#N/A	#N/A	#N/A					
3	values	#N/A	#N/A	#N/A	#N/A	#N/A					
4	(up to ten)	#N/A	#N/A	#N/A	#N/A	#N/A					
5		#N/A	#N/A	#N/A	#N/A	#N/A					
6		#N/A	#N/A	#N/A	#N/A	#N/A					
7		#N/A	#N/A	#N/A	#N/A	#N/A					
8		#N/A	#N/A	#N/A	#N/A	#N/A					
9		#N/A	#N/A	#N/A	#N/A	#N/A					
10		#N/A	#N/A	#N/A	#N/A	#N/A					
11		#N/A	#N/A	#N/A	#N/A	#N/A					
12	No of vals.							Sort keys			Ranking
13	Examples	#N/A	#N/A	#N/A	#N/A	#N/A					
14	(up to 20)	#N/A	#N/A	#N/A	#N/A	#N/A					
15		#N/A	#N/A	#N/A	#N/A	#N/A					
16		#N/A	#N/A	#N/A	#N/A	#N/A					
17		#N/A	#N/A	#N/A	#N/A	#N/A					
18		#N/A	#N/A	#N/A	#N/A	#N/A					
19		#N/A	#N/A	#N/A	#N/A	#N/A					
20		#N/A	#N/A	#N/A	#N/A	#N/A					
21		#N/A	#N/A	#N/A	#N/A	#N/A					
22		#N/A	#N/A	#N/A	#N/A	#N/A					
23		#N/A	#N/A	#N/A	#N/A	#N/A					
24		#N/A	#N/A	#N/A	#N/A	#N/A					
25		#N/A	#N/A	#N/A	#N/A	#N/A					
26		#N/A	#N/A	#N/A	#N/A	#N/A					
27		#N/A	#N/A	#N/A	#N/A	#N/A					
28		#N/A	#N/A	#N/A	#N/A	#N/A					
29		#N/A	#N/A	#N/A	#N/A	#N/A					
30		#N/A	#N/A	#N/A	#N/A	#N/A					
31		#N/A	#N/A	#N/A	#N/A	#N/A					
32		#N/A	#N/A	#N/A	#N/A	#N/A					
33	No of egs.										
34	Entropy										
35	table										
36											
37											
38											
39											
40											
41											
42											
43											
44											

The empty worksheet template

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they are extremely fluid, being based only on the particular set of examples. Add or delete a single example and the entropy could change substantially — the assertion that swans are white has zero entropy in Europe but a much higher entropy in Australia. Similarly, as the program works its way through, it will take different subsets of examples and the entropy that appears for any attribute value is likely to be quite different each time.

Program structure

The first step is to sort the attribute columns into the optimum order. The most efficient rule will begin with the attribute that gives most information about the outcome (has lowest entropy) and work through to the least informative. Then, working column by column across the table, examples must be classified into blocks which correspond to the branches of a decision tree. In the first column, this is simply a matter of sorting the examples so that all those with the same value are together and the values are in ascending order of entropy.

We begin with a table of examples — each column is an attribute, each row is an example showing an actual combination of values for those attributes. The program condenses this information into the most efficient form. Fortunately, a spreadsheet is ideal for displaying and manipulating tabular data. A program's operations will be done within the example table, sorting and deleting entries until what is left — the rule — is as efficient a description of the original table as possible.

	A
1	**Rule Induction**
2	
3	● Jack Weber January 1987
4	
5	**Program**
6	count the number of allowed values for each attribute
7	=SELECT(!$B$12:$F$12)
8	=FORMULA.FILL("=Macros!Countup(R[-10]C:R[-1]C)")
9	count the number of attributes
10	=SET.VALUE(A13,1)
11	=SET.NAME("attributes",0)
12	=SET.NAME("attributes",attributes+SIGN(INDEX(!$B$12:$E$12,A13)))
13	=A13+1
14	=IF(A13<5,GOTO(A12))
15	count the number of examples
16	=SELECT(!$B$33:$F$33)
17	=FORMULA.FILL("=Macros!Countup(R[-20]C:R[-1]C)")
18	work out the entropy of each attribute value
19	=SELECT(!$B$34:$E$43)
20	=FORMULA.FILL("=Macros!Entropies(RC,1,20)")
21	work out the overall entropy of each attribute
22	=SELECT(!$B$44:$E$44)
23	=FORMULA.FILL("=Macros!Sumentropies(RC)")
24	sort all the attribute columns in order of increasing entropy
25	=SELECT(!$B$1:$E$44,!$B$44)
26	=SORT(2,"R",1)
27	Now that attribute columns are sorted into a classification hierarchy,
28	sort examples according to their entropies within each column.
29	Begin by creating a sort key based on the first attribute.
30	=SELECT(!$G$13:$G$32)

An example of the Excel rule induction program. The full listing is in Program File

If:				then:
DISPLAY=	HD SPEED=	RAM=	CPU=	PRICE=
EGA				5000
MDA	fast			5000
	slow			4700
Hercules	slow	1000		4700
		512	8	4700
			10	4400

The completed rule

Suppose that the first attribute has three values; after sorting, they will form three blocks of examples (branches of the tree). The second attribute column is then tackled as if it were three separate sets of examples. Within each of these three blocks, the values of the second attribute are sorted to create a second level of sub-blocks. If the second attribute has two values, there will now be up to six (3*2) blocks. This sub-division continues until all the attributes have been done. In any column there may be one or more values which give a constant outcome — like the block formed by the EGA display type. Such values have zero entropy and do not need to be considered any further because subsequent attributes can have no effect. That branch of the tree is now fully resolved and, within that block, all columns to the right will be cleared.

If our choice of attributes were appropriate, all the examples will have reached zero entropy by the final column. Any remaining non-zero blocks represent conflicting data which may need additional attributes to resolve them or may simply contain inappropriate examples. For instance, the sample table contains only machines with 20Mbyte hard disks. Clearly it would be foolish to include a model with a 30Mbyte disk as it is not a fair comparison (though, of course, hard-disk capacity could have been chosen as one of the attributes). The program allows the user to remove all conflicting data or leave it in, in which case the output of a branch will appear as a list of the different outcome values that it leads to.

The example data is now very nearly in its final form but further tidying up may still be necessary. In particular, duplicate lines may now be present since examples which originally differed only in their values of an attribute that was found redundant will now, after pruning, be identical. The program will remove any such duplicates and re-sort the table so as to sink empty lines to the bottom. Finally, within each block, columns of identical values will appear. All except the first entry are cleared to create a neat, uncluttered layout, and the now much reduced example table is copied into a separate area of the worksheet laid out to present the induced rule (see 'The completed rule' table).

To achieve all this, the program must sort by columns and by rows; this is done by providing additional tables around three sides of the example area. Above it is a table listing all the possible values of each attribute and of the outcome. Below it lies a table in which the entropies corresponding to each attribute value are stored — these two tables match each other so that the third value in the second column has its entropy in the third position of the second column down below. At the very bottom lie the overall entropies of each attribute which provide a key for sorting the columns.

To the right of the examples lies a table of sort keys in which entropy values corresponding to each example are entered and used to sort the rows within each block. A column at the far right holds a final sort key based on a ranking associated with each block of the first attribute. This is used to deal with situations in which a value with low entropy nevertheless requires more attributes to resolve it than another that began with higher entropy but was then quickly resolved by a subsequent attribute. By selecting complete columns and rows across all the tables, it is easy to keep associated entries lined up throughout all of these sort and deletion operations.

Using the program

Excel offers worksheets, which are con-

ventional spreadsheets, and macro sheets which contain the program (command macro) and any specially created functions (function macros) that can then be put into worksheet cells or called by the command macro.

The first thing to do is to prepare and save a template for the example tables on the worksheet. Note that two of the tables on the previous page have been initialised to the error value #NA to differentiate blank cells, which would be treated as containing the number zero, from cells that may have zero as an actual value. The template has been designed to accommodate 20 examples with up to four attributes, any of which may have up to ten values (numbers, text or Booleans). It is perfectly possible to set up much larger tables but the relevant cell references will have to be changed in the program.

Next, the main program and the special functions need to be put onto a macro sheet called 'Macros'. It is good programming practice to use labels for all cell references; I have deliberately not done so because the program contains many loops, often nested, and instructions like =GOTO(loop5) are harder to follow in a long program than =GOTO(A57). Similarly, loop counters have been put into cells rather than named as this makes debugging easier if one examines cell values during execution.

One consequence of this approach is that the program must be entered exactly as it is, at the very least allowing blank lines where text comments now exist. When complete, unwanted comments or spaces can be removed and Excel will automatically adjust all cell references. Labels in bold type mark the start of individual macros and must be defined (using the Define Name command) so that the macros can be called. 'Program' is a command macro; all the rest are function macros that return a value.

To use the program, make the worksheet window active, enter the lists of permitted values and the actual examples in the areas initialised to #NA, and run the Program macro from the menu bar. As the program runs you will see values being filled in and examples being sorted and pruned. The final rule will emerge in about five to ten minutes.

Limitations

It cannot be stressed too strongly that rule induction takes the adage 'garbage in — garbage out' to new heights. It is not a substitute for thought. Given well-chosen examples CLS/ID3 creates excellent rules, but it is particularly susceptible to conflicting examples. This lays the responsibility on the user to supply good data — the examples being entered must be ones that can reasonably be expected to be comparable. As many examples as possible should be entered. If conflicts do appear, consider why they are there — unfair comparisons, poor choice of attributes or simply because this is the one exception that proves the rule.

END

Further reading

Machine Learning by R Forsyth (*Artificial Intelligence: principles and applications* by M Yazdani — Chapman and Hall 1986)

Finding Rules in Data by B and W Thompson (*Byte* — November 1986).

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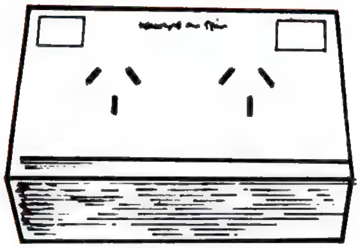

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From this issue, APC's connectivity section will begin with a look at world-wide communications-related news. This column will focus on developments as they are announced (and in many instances, before they are announced), not necessarily as they become available from local distributors in Australia. The rationale for this lies in the danger of choosing inappropriate connectivity hardware or software. It is far better to know what lies in the immediate future when pressed to make an expensive decision in the present.

LAN gateways speed data transfer

Pathway Design last month introduced two high-speed local area network gateway packages that let NetBIOS LANs exchange data with IBM mainframes at rates of up to 56kbits per second (bps).

Pathway's new netPATH SNA-3270/NetBIOS gateway software allows up to 32 PCs on a NetBIOS LAN to conduct remote 3270 sessions simultaneously with a host IBM mainframe. It emulates IBM's 3174 remote cluster controller as well as 3270 terminals.

The 3270 gateway package also includes management software that allows monitoring and analysis of gateway communications traffic.

For the batch transfer of files, the new netPATH SNA-3770 gateway software allows as many as six networked PCs to simultaneously emulate IBM 3770 Remote Job Entry (RJE) workstations.

Both of Pathway's new gateway programs run on the firm's existing Intelligent Communications Adaptor (ICA) board. Pathway's ICA is a half-slot PC card that includes its own Intel 80188 processor and memory to speed data transmission.

Prime link to PC

Prime Computer has announced enhancements to its Primelink micro-to-minicomputer and terminal-emulation software that allow PC users to download data from a Prime minicomputer directly into PC applications, including Lotus spreadsheets.

Primelink 3.01 will also allow PC users to perform unattended file transfers, spool print files, transfer multiple files, support colour monitors and graphics and emulate a variety of terminals.

Once connected to the Prime via an RS-232C protocol, PCs can be used as Prime PT200 or other popular terminals such as Digital Equipment's VT100 and VT220, IBM's 3278, and Applied Digital Data Systems' Viewpoint 60.

According to the company, Primelink users will be able to use their PCs as normal stand-alone workstations but can still take advantage of shared resources, such as printers and mass storage, using standard DOS and application commands.

A new feature to version 3.01, Virtual Printing, can reduce printing time for PCs by spooling data into the Prime minicomputer. For users of Lotus, Primelink Data Access software allows users to extract data from Prime's Information and Oracle database systems and import it into Lotus 1-2-3 files; all from within Lotus using regular 1-2-3 commands.

Operating system gains file locking

Nestar Systems has upgraded the operating system software for its PLAN Series local area networks to include file locking under DOS 3.2, NetBIOS support and improved performance through disk caching on the LAN server.

The new system software also allows Nestar PLAN Series servers to support token-ring and ARCNet LANs concurrently. As with previous versions of Nestar's LAN operating system, System Release 6.0 runs exclusively on the firm's proprietary PLAN Series file servers: the PLAN 3000 desktop server and the PLAN 5000 floor-standing model.

By supporting file locking under DOS 3.2, Nestar's PLAN Series System Release 6.0 allows a broader range of multi-user applications, particularly network database packages, to operate on Nestar LANs, according to Nestar officials.

The new support for DOS 3.2 locking calls replaces Nestar's proprietary locking scheme, which had required LAN software developers to modify their applications especially for Nestar systems to support multi-user operation. System Release 6.0 is the first product to incorporate Nestar's implementation of NetBIOS, company officials said.

IBM to enter T-1 multiplexer market

IBM is working to meet the voice-data integration and high speed communications needs of its customers by offering a series of T-1 multiplexing products. T-1 links combine data and voice over 1.54Mbit-per-second transmission lines.

At the International Communications Association conference in New Orleans last month, Ellen Hancock, president of IBM's Communications Product Division, told telecommunications planners that IBM soon plans to offer two T-1 multiplexers, one for general communications and another to link 370 mainframes.

"Customers want to take advantage of high-speed digital transmission so we intend to announce a product that allows them to share bandwidth between their voice and data applications that may run on the CBX phone system or communications controllers," Ms Hancock said.

According to Ms Hancock, IBM will use T-1 multiplexers to link 370 mainframes.

Besides the 370 links, IBM will market a T-1 multiplexer from a third-party vendor to meet growing communications demands.

Ms Hancock would not specify when the T-1 systems would be released. But corporate use of T-1 systems has been growing steadily.

10-Net to support SMB, NetBIOS

Fox Research plans to incorporate two industry-standard network protocols and

software interfaces into its 10-Net local area network operating system.

Release 4.0 will support the Server Message Block (SMB) protocols and NetBIOS programming interface used in IBM's Token-Ring and PC Networks and most software-compatible LANs, said Robert Setterbo, director of software development at Fox. The new version will allow software written to use SMB and NetBIOS to run on Fox's 1Mbit-per-second LAN.

Like all versions of 10-Net, Release 4.0 uses the CSMA/CD network access protocol used in standard Ethernet networks, and either twisted-pair or fibre-optic cabling. Version 3.2 added support for the star topology specified in the proposed IEEE StarLAN standard, as well as 10Net's traditional bus configuration.

Release 4.0, scheduled for September 1987, is the first to support the emerging standards for network applications software.

"This move to the SMB protocol and to NetBIOS places Fox squarely in the mainstream of the industry connectivity movement," Mr Setterbo said.

IBM 9370 comms announcements expected soon

IBM plans to announce a number of new products for its midrange computing systems, according to industry sources close to the company.

The announcements have not been confirmed, but IBM users, resellers and consultants anticipate that IBM will deliver promised communications support for its 9370 Information Systems. IBM most likely will announce software for the 9370 processors to support the X.25 international communications protocol, sources said.

When the 9370 family was introduced, IBM announced a card, called the Telecommunications Subsystem Controller, to support X.25 links. However, no software has been announced to take advantage of that controller.

At a consultants' conference in April, held in Phoenix, USA, IBM pledged to provide X.25 and other needed communications software support for the 9370 within 60 days.

As with X.25, IBM has announced hardware for other communications links but has not revealed its communications software plans. Along with the telecommunications controller, the 9370 accommodates boards for connections to Ethernet and IBM Token-Ring local area networks as well as ASCII terminals, but supporting software has not been announced.

Sun plans 'seamless' integrated networks

Sun Microsystems last month revealed Open Systems Network (OSN), its strategy for connecting everything from a PC to a supercomputer on a single network.

Sun's strategy calls for the merger of its existing networking technologies with those of its recently acquired subsidiary, Centram Systems West, maker of the TOPS local area network, into a single system that provides transparent file access from PCs to supercomputers.

Sun also announced four new products in its SunLink family of data-communications products that enable Sun workstations and serves to attach directly to an IBM mainframe channel.

Sun's new SunLink products include the SunLink Channel Adaptor, a device that connects data channels of differing equipment, such as Ethernet LAN and IBM mainframe channel.

Running over the SunLink Channel Adaptor is SunLink Local 3270. The software allows a Sun workstation to emulate a locally attached IBM 3274 cluster controller, providing 3278 terminal emulation, 3270 PC-compatible file transfer and a Datastream Access Interface (DAI) at channel speeds (3Mbytes per second).

Sun also announced SunLink SNA Peer-to-Peer, software that supports IBM's APPC (Advanced Program-to-Program Communications) and DIA (Document Interchange Architecture).

Finally, the company announced the SunLink Multiprotocol Communication Processor (MCP) board, which allows Sun systems to communicate with multiple devices and run several protocols concurrently.

The new SunLink products will be delivered in August.

DCA unveils Mac, LAN 3270 links

Digital Communications Associates (DCA), announced at the Comdex trade show new 3270 emulation systems for the Apple Macintosh SE and II computers, along with new products for the IBM PS/2 and a new line of IrmaLAN software for local area network mainframe gateways.

The new Apple products, called MacIRMA, provide IRMA 3270-type mainframe terminal emulation over ordinary coaxial cable connections for the new Macintosh machines.

While DCA will produce two versions of MacIRMA, one for the Mac II and one for the Mac SE, both products will have the same user interface, according to company representatives. The user interface on MacIRMA differs greatly from the command line PC-DOS interface found on the IBM PC IRMA products.

"We have designed a piece of software that looks like any other piece of Mac software," said Tom Lenahan, MacIRMA product specialist at DCA. "We use the pull-down menus and the mouse just like all other Mac software."

However, not all features will be found in the first software release. The most notable exception is support for A Programming Language (APL) characters, which is scheduled for the second release of software, according to Mr Lenahan.

PCs on a Token-Ring LAN can directly connect to the mainframe in one of two ways. One method is to run the new workstation software in what DCA calls 'LAN-attached stand-alone', so that the PC talks directly as a Physical Unit 2.0 node to the mainframe.

Another method would be for the PC workstation software to run one of the Logical Unit nodes from the IRMALAN 3725 Gateway. This second method uses less memory in the 3725 controller, but suffers in terms of performance.

IBM to publish SNADS interface

IBM will continue to publish its key communications architectures, including its Systems Network Architecture Distribution Services (SNADS), a heretofore unpublished architecture for store-and-forward transmission of messages and documents over an SNA network, an IBM official said last month.

Though the official declined to say when IBM might publish an API which would allow users and third parties to write SNADS applications, he implied that an open SNADS interface is inevitable.

Although IBM and third party vendors offer SNADS applications, the lack of published API prevents third party developers and end users from writing programs that add functions to SNADS

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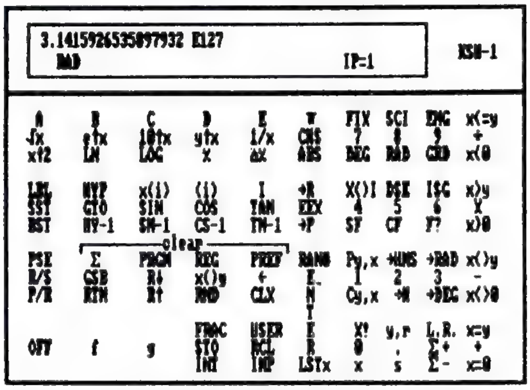

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A shared network spreadsheet

Patrick Horton and Michael Morris discuss transparent sharing of data between multiple users on a LAN.

From its popularisation with Dan Bricklin's VisiCalc in the late 1970s to the multi-dimensional powerhouses available today, the spreadsheet has become the centerpiece around which many business systems are built. The same period of time has seen remarkable growth in the microcomputer LAN as well. As these two trends grew in parallel, the need for a merging of technologies — a spreadsheet that would work effectively in a LAN environment — became evident. Software Products International has created a shared network spreadsheet as part of the Open Access II Network.

The primary design goal for the spreadsheet was a transparent, simultaneous sharing of data between multiple users. Typically, in previous attempts at a shared spreadsheet, one user could make changes and update the disk copy of the file. Though subsequent users could read the disk copy, they couldn't update the same disk file. Thus, changes made by one user were not transmitted to others. To avoid these problems, we built a new set of virtual-memory routines that allow subsequent users to access the correct data by keeping the disk-based portions of the spreadsheet current.

Why use virtual memory?

When we compared RAM-resident and virtual-memory data structures, we found that the RAM-resident structure could access data more quickly, because it didn't need to check whether parts of the spreadsheet were on disk or in memory. On the other hand, the virtual-memory data structure let us create spreadsheets larger than the machine's memory capacity. In addition, a RAM-resident spreadsheet requires that a correct copy of the spreadsheet exists in memory at all times. A change by one user must be transmitted and received by all users. With a virtual-memory spreadsheet, the data is always written to disk and is available for transmission to all users. All stations sharing the spreadsheet receive the update only when they need it.

You can optimise the data structure so that areas that must be swapped from memory don't need to be written unless they have changed. You can easily locate changes by writing updates to the disk through a virtual-memory scheme. This optimisation uses an LRU algorithm: the least recently used areas remain on disk; the most recently used areas remain in memory.

Under lock and key

If you use shared information in a multiuser environment, you need three levels of spreadsheet locking: no locks, shared locks, and exclusive locks. If you are merely viewing information and don't care about its currency, you can use no locks. For instance, if you use the cursor-control keys to look at a spreadsheet without placing any criteria on the data you see, you don't need to lock it.

If a number of users want to share information without changing it, as when you print an area of the spreadsheet, you need a shared lock. In concept, when you request a printout, you expect the final copy to reflect the information that was in the spreadsheet *at the time* you issued the request. A shared lock won't let anyone change the spreadsheet until the printout completes.

If you want to change data in the spreadsheet, as when you recalculate an area, you need an exclusive lock. An exclusive lock prevents anyone else from performing a function that requires a lock — for instance, trying to print an area that's being recalculated. Likewise, if you type a new value into a cell on the spreadsheet, you need an exclusive lock on that cell for a short time.

Another aspect of spreadsheet locking involves implicit versus explicit locks. Implicit locks are those the system assumes based on the operations you select: printing, copying, and so on. Explicit locks are those you actually select. Explicit locks are essential to a multi-user spreadsheet environment. For instance, if you know you will be repeatedly changing one area of a spreadsheet, you can request an exclusive lock on it. This lock prevents anyone else from changing or printing that area of the spreadsheet until you finish with it and release the lock.

Traffic control

Although the virtual-memory scheme

```
Update Transmission (Area Unlock):
  IF Exclusively_Locked(Area) THEN
    Write_to_Disk(Area)
    Add_to_Update(Area)
    Remove_Lock(Area)
Update Check:
  IF Update_Pending(My_Node) THEN
    Flush_From_Memory(Update_Area)
    Mark_As_Updated(My_Node)
    IF Area_On_Screen(Update_Area) THEN
      Rebuild_Screen
```

Listing 1 The basic communications mechanism for the shared network spreadsheet. This shows how a node receives updates from other nodes on the network; it also shows how a node broadcasts changes to those nodes

supports the spreadsheet data, you still need internodal communications to support the locks and update information. Let's look at some alternative methods of implementing locks on a network: peer-to-peer communications, semphores, exclusively locked files, MS-DOS record locking, and lockfiles.

Peer-to-peer communications (session links) literally transmit information from one network node to another with a specified protocol. This would, at first glance, seem to be an ideal way to communicate updates: if you change an area, you transmit that change directly to everyone else using the spreadsheet. However, this is not practical for two reasons. First, to transmit a change to other nodes, you must establish a session between the node making the change and every other node using the spreadsheet. If one of the nodes is performing an operation, then you must either wait until it is finished before you establish the session or else interrupt it. Second, peer-to-peer communications increase the amount of traffic over the network tremendously, particularly when you change a large area of the spreadsheet.

A semaphore acts as a signaling mechanism that allows only one node to perform a certain operation at a time. Any other node that needs to perform that operation must wait until it receives that same (unique) semaphore. Semaphores are useful in controlling time-dependent operations that could cause data corruption. The problem is that neither MS-DOS 3.1 nor NETBIOS provides a standard for using them.

MS-DOS 3.1 provides extended file-open capabilities and record-locking routines that can emulate the action of a semaphore. You can make certain file operations, like renaming a file, dependent on whether you can exclusively open a file, thus preventing other nodes from doing the same thing. However, using these locks, which apply to an entire file, can be cumbersome and slow on the network, and exclusively opened files alone don't provide enough information to lock areas on a network spreadsheet. MS-DOS record-locking routines also aren't suitable for area locking because when you use a virtual-memory scheme, the logical areas of the spreadsheet don't necessarily correspond to physical disk storage.

Another approach is to use a separate disk-based lockfile to provide communication to other nodes on a LAN. You can control operations on the lockfile with the MS-DOS file-open and record-locking protocols, and the lockfile can contain information that


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Why lockfiles work

The lockfile provides more flexibility than the MS-DOS record-locking scheme. For one thing, it can keep track of who has locked a particular file. If a conflict occurs, you can return this information through the user interface. There is some performance overhead since these files must exist on the disk, but the cost is negligible compared to that of record-locking schemes or direct peer-to-peer links.

The scheme for the shared network spreadsheet contains three lockfiles, one each for file control, area control, and update control. The file-control lockfile lets you open the spreadsheet file in various modes, including some not supported by MS-DOS. This eliminates the need to use MS-DOS file-open routines. To control area locking, you store the starting and ending row and column identifiers in the area-control lockfile. This lockfile knows whether the lock is exclusive or shared and who has it. Conflicts (intersections) are thus easy to detect.

The update lockfile contains information about any areas that other nodes have changed. It also keeps track of whom has received each update. Thus, after everyone has received it, you can remove it from the update file. A node that receives an update need mark only the affected area of the memory-resident version; this mark indicates that the area has been changed on disk. When the current version is needed, the node can read it in from disk.

Keeping up to date

Since any change to the spreadsheet requires an exclusive lock, releasing such a lock potentially triggers an update. Likewise, you can assume that unless an area is being unlocked, no updates are pending. This interaction means that the routines that handle unlocking must also communicate update information.

Update information must be able to identify the spreadsheet as well as delimit the area within it that changed. When a node checks the update lockfile, it receives any updates that are waiting. This checking process is initiated by either a periodic time-out (during the keyboard-input routine) or an area-lock request. You can vary the length of time between checks to optimise system performance. If you have too many checks, you'll have a lot of unnecessary network traffic; if you have too few, your system won't perform consistently from a user's point of view. Listing 1 contains the basic mechanism by which a node receives updates from and broadcasts changes to other nodes.

Although each node needs updated grid data, some aspects of a spreadsheet remain unique: where you are in the model, what area you have set up for graphics, and so on. These data structures remain RAM-resident, and the last one you saved is the one you get when you reenter the spreadsheet.

The missing links

The secrets to this shared network spreadsheet and other shared network applications are virtual memory and lockfiles. Some increase in network traffic will occur as the system transmits and receives changes. On a slower system, such as a disk-based operating system with a nondedicated server, this extra traffic might make shared applications impractical. Since any change must be written to disk, the spreadsheet is essentially disk-based anyway. Some operations will undoubtedly be slower than in a memory-resident data structure that doesn't need disk access.

You can optimise the system somewhat. The overall goal of optimisation is to minimise network traffic as much as possible. One possibility would be to optimise the multi-user version for single use. When you load a spreadsheet, you can open the whole file exclusively so that other nodes can't access it at all. This would allow you to perform operations without locking an area, writing to the disk, or adding update information to other nodes.

If you design the LRU algorithm carefully and use lockfiles to control access to the disk-based portion of the virtual-memory structure, you can implement shared network applications effectively. Desktop publishing and word processing have yet to be produced in 'true' network versions, and there are undoubtedly other applications as well. The effort to design and program any of these would be significant, but definitely worthwhile.

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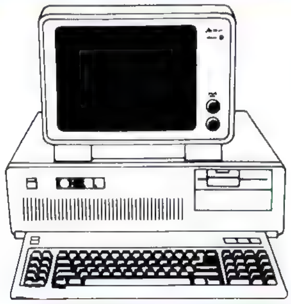

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LAN hardware standards

The myriad network options available has finally been brought under control. Art Krumrey and John Kolman discuss this new set of flexible standards for the prevalent hardware protocols.

As local area networks have proliferated, the need for standards has become evident. Dozens of hardware interfaces, topologies, and cable types, as well as network control programs and operating systems that run on different hardware are available. Because considerations such as wiring plans, network size, and cost versus performance vary greatly, it is unlikely and even undesirable that a single LAN standard could exist.

Instead, groups from the Institute of Electrical and Electronic Engineers (IEEE) and American National Standards Institute (ANSI), with representatives from many companies, have written a family of specifications for LAN hardware. Formal definitions for networks such as Xerox's Ethernet, AT&T's StarLAN, and IBM Token-Ring Network are included. These standards, in addition to the de facto ARCnet standard developed by Datapoint, enjoy a large measure of multi-vendor support.

Unlike its earlier dominance in setting internal hardware and software standards for desktop computers, IBM has been slower to participate in the development of universal communications standards. Its competitors, however, have been in the forefront in applying their own standards to PC connectivity, particularly in LANs.

Today, most manufacturers are settling on one of three LAN hardware standards, formalised by ANSI and IEEE; selecting software in a separate decision. The designer and installer must understand these LAN standards and their role in building a network in order to figure out all the options.

It all starts with OSI

In late 1981, formal liaison was established between the IEEE and the European Computer Manufacturers Association (ECMA), and the result was the stated objective that all standards should be in accordance with the open system interconnection (OSI) reference model of the International Standards Organisation (ISO). The seven layers of the OSI model are listed in Table 1. Layers 1 (physical control) and 2 (logical link control and medium access control) are the ones treated by IEEE standards. Layer 1 dictates what type of cable is used, and this can be the LAN design decision that most affects installation costs and future applications.

The five upper layers are mostly proprietary, although some ISO standards exist for particular networks — for example, the manufacturing automation protocol (MAP). These layers are implemented entirely by software. Layer 1 is implemented by hardware, and layer 2 by a combination of hardware and software, depending upon the degree of intelligence that the vendor places on the network interface card (NIC).

Four IEEE standards address the two lowest layers. At this time, the ISO boundaries at layers 1 and 2 correspond with the IEEE standards, but whether the final ISO definition for the

Layer	ISO Model Description	IEEE Standard
7	Application	N/A
6	Presentation control	N/A
5	Session control	N/A
4	Transport end-to-end control	N/A
3	Network control	N/A
2	Logical link control	802.2
	Medium access control (MAC)	802.3, 802.4, 802.5
1	Physical control	802.3, 802.4, 802.5

Table 1 OSI model and IEEE 802 standards. The IEEE 802 LAN standards deal with the implementation of layers 1 and 2 of the OSI reference model. Logical link control (802.2) is common to all media

separation of layers 2 and 3 will fully correspond with the IEEE boundary is still unknown. The IEEE standards are defined as follows:

802.2 Data or logical link control
802.3 Carrier sense multiple access with collision detection (CSMA/CD) bus LANs (for example, Ethernet and StarLAN)
802.4 Token-passing bus LANs (for example, MAP; ARCnet is similar)
802.5 Token-passing ring LANs (for example, IBM Token-Ring Network)

An 802.6 standard is being developed for metropolitan area networks using CATV technology, and 802.7 will cover broadband networks. These types of wider area networks can function as a bridge to departmental LANs.

A companion IEEE document, 802.1, describes the relationship among the standards as well as their position in the OSI model. This document also covers the relationship of the 802 standards to higher-layer protocols and treats network management and communications between networks.

The upper part of the ISO's layer 2 corresponds to the IEEE's 802.2 standard, logical link control (LLC). LLC can be either connectionless (class I) or connection-oriented (class II). The connectionless service is used when higher layers provide recovery and sequencing services, so they do not need to be replicated in the logical link layer. It is also used when the delivery of every data unit in the logical link layer does not have to be guaranteed. The connection-oriented LLC provides services comparable to synchronous data link control (SDLC) or high-level data link control (HDLC) protocols, including sequenced delivery of data units in the logical link layer and a comprehensive set of error recovery techniques.

The medium access control (MAC) sublayer and the network control layer communicate with LLC by a set of three service primitives: 'request', which asks that a service be initiated — a signal from the adjacent layers to LLC; 'indication', which signals a response from LLC to adjacent layers about a request or signals an event internal to LLC; and 'confirm', which signals a response from LLC to adjacent layers about the results of one or more previous requests.

For connectionless services LLC processes requests for unacknowledged connectionless data transfer. For connection-oriented services, requests are processed for connection establishment, connection-oriented data transfer, connection termination, connection reset, and connection flow control.

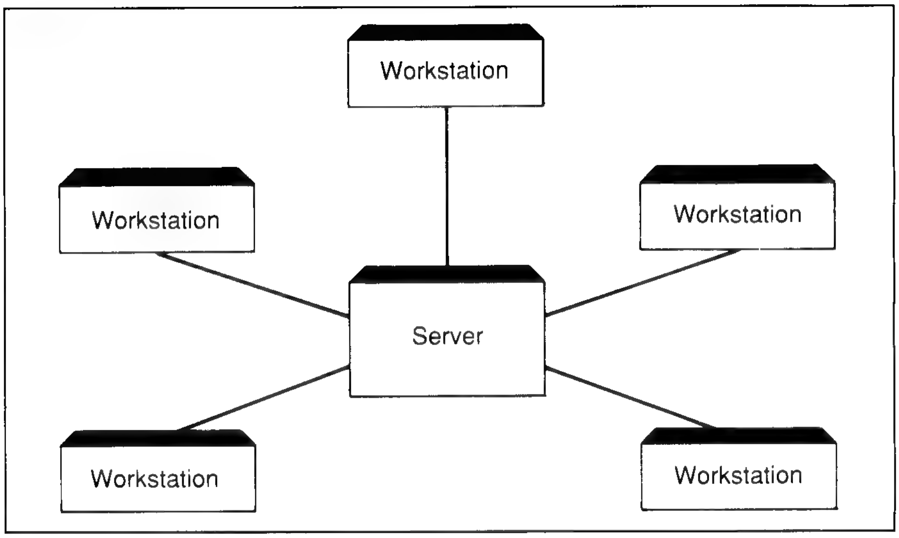

Fig 1 Star topology. A star network uses dedicated cables to connect all stations to a central hub. The pure star places the server there, thus avoiding contention on the cables

Hardware strategies

Dozens of companies manufacture LAN hardware that adheres to one of the standards defined by IEEE/ANSI: CSMA/CD, token-passing bus, and token-passing ring. The selection of a LAN hardware standard involves seven factors: (1) transmission medium; (2) topology; (3) line access method; (4) speed; (5) cable type; (6) geographic span; and (7) address size.

Transmission medium. Two types of signalling methods can be used along the LAN cable: baseband and broadband.

In baseband systems, a stream of digital bits is sent on the network by raising and lowering the voltage, using the Manchester encoding method. The transmission, which takes place at hundreds of millions of times a second, has some of the properties of a radio signal; thus, phenomena such as standing waves can occur if cable length restrictions are not followed. Standing waves are caused by reflected signals and can produce signal distortion and loss because the reflected signal interferes with the original signal.

The broadband medium actually uses radio frequency signals to transmit one or more network signals, perhaps along with radio and television signals on the same cable. The network information is sent on channels of frequency with separate receive and transmit frequencies. Several baseband-style networks, such as Ethernet, can be implemented on the same broadband cable along with other radio information.

Broadband requires NICs that create a radio frequency signal, as well as perform the other protocol functions of baseband. Further, the integrity of the network can be jeopardised by the frequency drift of any node's transmitter. The cost of the electronic components to perform the extra functions makes broadband NICs more expensive than others. Broadband is often used as a high-bandwidth bridge between less expensive baseband networks.

Topology. Topology refers to the layout scheme of a LAN. The major topologies are star (Fig 1), linear bus (Fig 2), and ring (Fig 3). Each of these topologies can be defined two ways: 'logical topology' is the method by which the networked workstations contend for the media and pass messages; 'physical topology' is the actual physical manner in which the workstations are wired. In general, the 802 standards address the logical topology and electrical interface issues within the network, leaving the physical wiring choices to the vendor.

In the pure (logical and physical) star topology, cable is arranged in the shape of a star, radiating from a central point — usually the server. Each cable to the server is unique; none is shared. Thus, the impact of a cable fault or NIC is limited to a single station. Because star networks have no shared resource, such as a bus, no complex protocol for sharing is needed, and none is defined by the

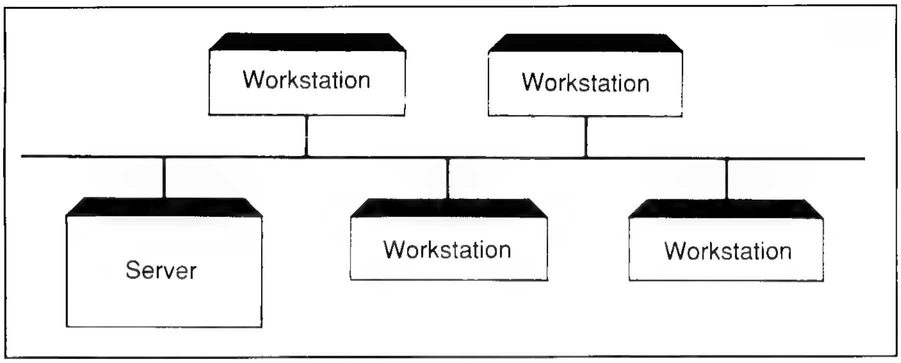

Fig 2 Bus topology. A bus network threads a single main cable through all stations. Sometimes, short cable spurs are used to connect the workstations to the bus

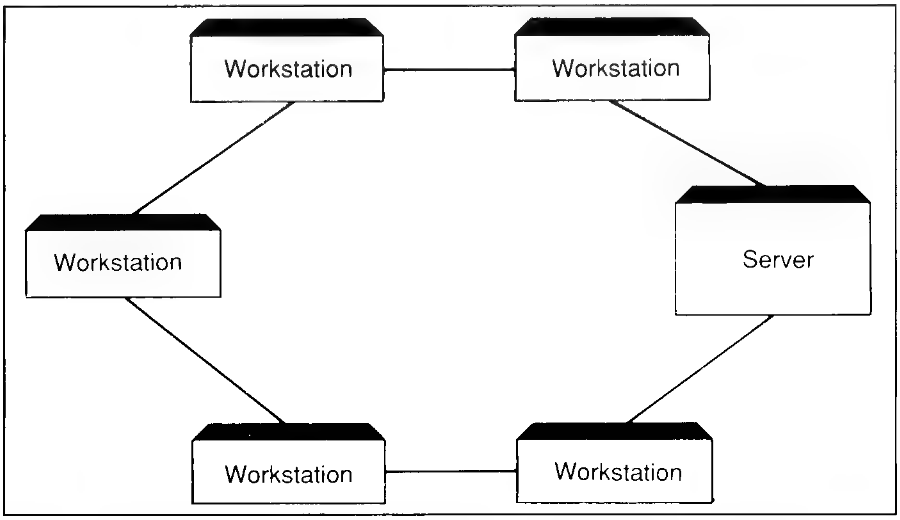

Fig 3 Ring topology. Ring networks thread a main cable through all stations, similar to the bus topology except that the ends of the cable are connected to form the ring

IEEE. Most star implementations have, in fact, been proprietary. The major disadvantage of the star topology is that it requires a lot of cable.

The linear bus topology has a single length of cable, called the bus, or trunk. Every device is connected to the bus and the ends are terminated — not connected to each other. Usually the devices are connected to the main cable by 'stubs'. In a typical configuration, the main cable is in the ceiling or wire channel and the stubs run to the workstation. Stubs are strictly limited in distance; for example, Ethernet's limit is six feet. Some variations, such as ARCnet, allow spurs from the bus, as long as the cable does not loop. Repeaters allow segments of cable to be connected by another medium — for example, fibre optic extensions of Ethernet.

The bus has the advantage of wiring simplicity, but any break in the cable can cause the entire network, or entire segment of a network with repeaters, to fail. The total failure is caused by one end of the bus losing a proper termination in a terminator resistor. The breaks can be hard to diagnose, especially in large networks.

Variants of the bus connect workstations in a physical star pattern but behave electronically as a bus. The prevalent example is AT&T's StarLAN.

A ring topology has devices connected in a series with the connection looping the last station to the first station, forming a ring of cable. All data passes through all devices. The sending device must listen for the packet it sent coming around from the other side, and not repeat it. Like a bus, any break in the cable causes the network to fail.

The star-wired ring (Fig 4) physically connects workstations in a star arrangement to a hub. The hubs are, in turn, connected in a wire ring. All devices are logically configured in a pure ring, with the hub serving as a connection point to nearby devices. The IBM Token-Ring Network is an example of this type. Another variant, the bus-wired ring, is used by 3Com for its 802.5 network. Both networks are electrically compatible and can be mixed.

Line access method. The line access method is a type of signalling used on a line that allows multiple devices to share the same cable, communicate on it, and not interfere with another device. The IEEE defines the two methods that distinguish bus LANs: CSMA/CD and token passing. The IEEE-defined ring network, 802.5, uses token passing.

The IEEE line access methods use the same type of error checking. Error detection is typically performed by the receiver hardware using the 32-bit frame check sequence cyclic redundancy check (CRC) field. The CRC checksum is formed as a function of the address, length, and data and pad fields. CRC is used as a more powerful and less risky error detecting mechanism than normal parity checking.

Speed. Among the standardised networks, the rate at which packets are transmitted on the network varies from StarLAN's 1 million bits per second (Mbps), token ring's 4 Mbps, token bus's 1 to 10 Mbps, and Ethernet's 10 Mbps. This raw data transmission speed is only one of many factors affecting the overall performance of the network.

Cable. The type of cable connecting workstations can greatly influence installation costs. CSMA/CD networks use two types of coaxial cable (coax) and twisted pair for StarLAN. Thick coax is used for Ethernet long runs; less costly thin coax can be used for short runs. Token-passing bus networks use several types of 75-ohm coax; for the fastest implementation, CATV-like semi-rigid cable is recommended. For token-ring networks, shielded twisted pair, such as IBM Cabling System type 2, is best. Unshielded twisted pair (ordinary telephone wire or IBM type 3) can be used in environments with low electromagnetic interference.

Geographic span. The maximum distance across the total network — the distance between the farthest nodes — is the geographic span. All 802 networks can be repeated or extended. Without repeaters, 802.3 CSMA/CD networks on thin coax can span 305 metres. Thick coax extends the span

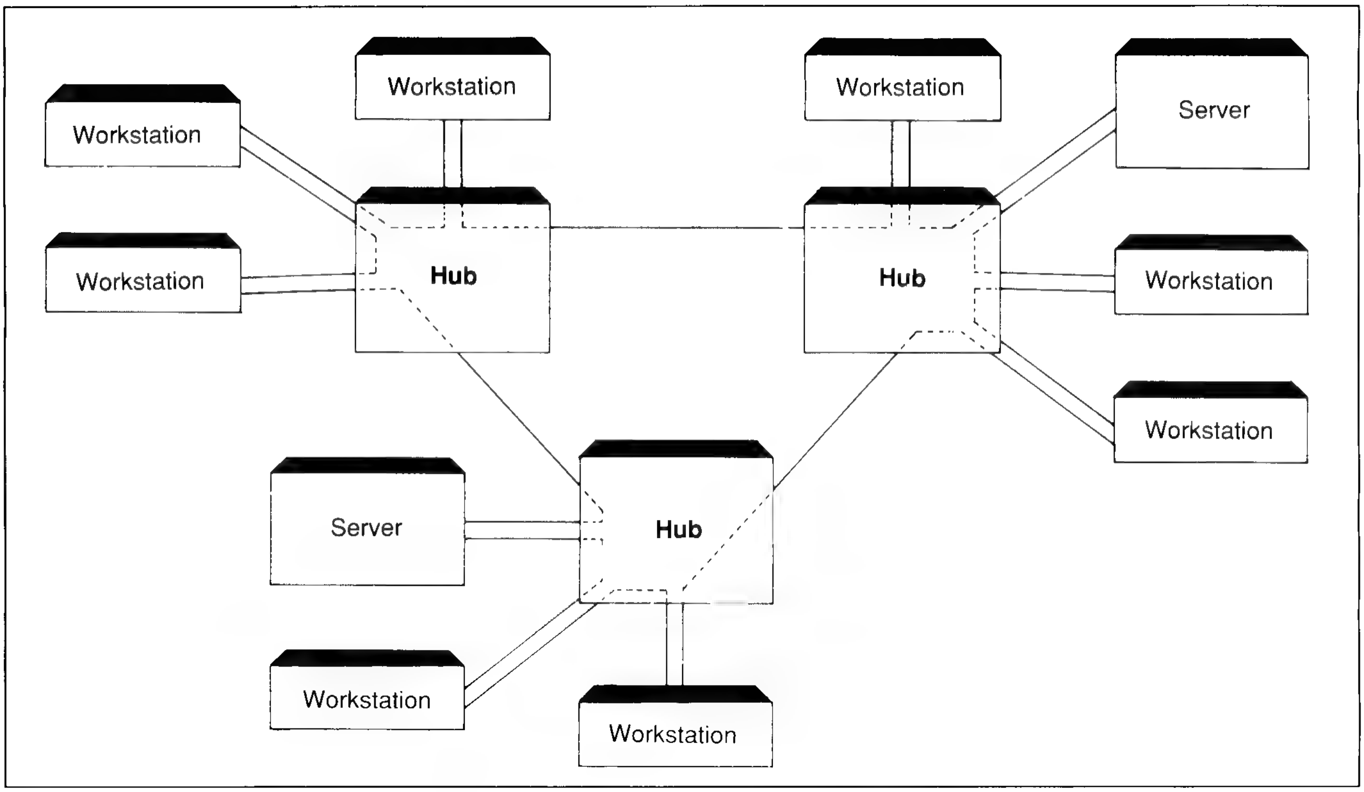

Fig 4 Star-wired ring. IBM's 802.5 Token-Ring Network is logically a ring, but physically wired as a star. This simplifies wiring and diagnostics

to 1000 metres. A token-bus network's span depends upon the expected performance. Token-ring cable can be up to 100 metres from the hub; the maximum span is 300-600 metres depending upon the exact arrangement of the ring.

Selective repeaters, also known as bridges, are another method used to expand networks. They use a store-and-forward feature to repeat only packets destined for segments attached to a particular repeater. Selective repeaters can improve the performance of multiple segmented networks because local segment packets are not forwarded.

Address size. The address size determines the number of different devices that can be connected to the network. All new CSMA/CD implementations use a 48-bit address; older implementations use 16 bits. Token buses and rings use either a 16 or 48-bit address, depending upon implementation. The 48-bit address is usually the manufacturer's code — as set by the IEEE — and serial number to provide a unique identification of all network devices.

The contention protocol

IEEE standard 802.3 for the CSMA/CD protocol evolved from the original baseband version developed by Robert Metcalfe and David Boggs of Xerox's Palo Alto Research Centre in the US in 1976. It has experienced widespread implementation not only by Xerox, but also by Digital Equipment, Hewlett-Packard, Intel, and 3Com. IBM has announced an 802.3 interface for its 370-class 9370 computers. CSMA/CD differs from other protocols in that control of network access is not centralised. Instead a degree of cooperation between network devices is required to share the communications media equitably.

Conflicts arise when more than one device attempts to transmit on the single shared cable at the same time. CSMA/CD is a contention protocol, which assumes that occasional conflicts will occur and defines the methods for detecting and correcting these conflicts. This approach differs from token-passing networks in that each device earns the right to transmit by receiving a token, which is a unique string of bits that serves as a control signal. Once a device takes possession of the token, it has the exclusive use of the communications media.

CSMA/CD can be better understood by defining the three elements that comprise its name:

Carrier sense. Before a device transmits it listens to ensure the media are not being used. A voltage pulse train, or carrier, is transmitted on baseband systems to indicate the media are in use.

Multiple access. As soon as the media are available a device can begin transmitting. There is no need to wait for a token or other type of poll before initiating a transmission.

Collision detection. Occasionally, more than one device may attempt to transmit simultaneously. When this happens a collision occurs. The transmitting device monitors the communications media for high voltage levels while transmitting. A voltage level greater than one that would be expected from a single transmitting device signals a collision.

After the transmitting station detects a collision it immediately terminates the transmission of data, instead sending enough jamming noise so that all devices on the cable will sense a collision. All transmitting stations then wait a random amount of time before they attempt to retransmit. The scheduling of the retransmissions is determined by a controlled randomisation process called 'truncated binary exponential backoff'. After each repeated failure on a transmission attempt, a station doubles the mean value of the random delay. As the network becomes more

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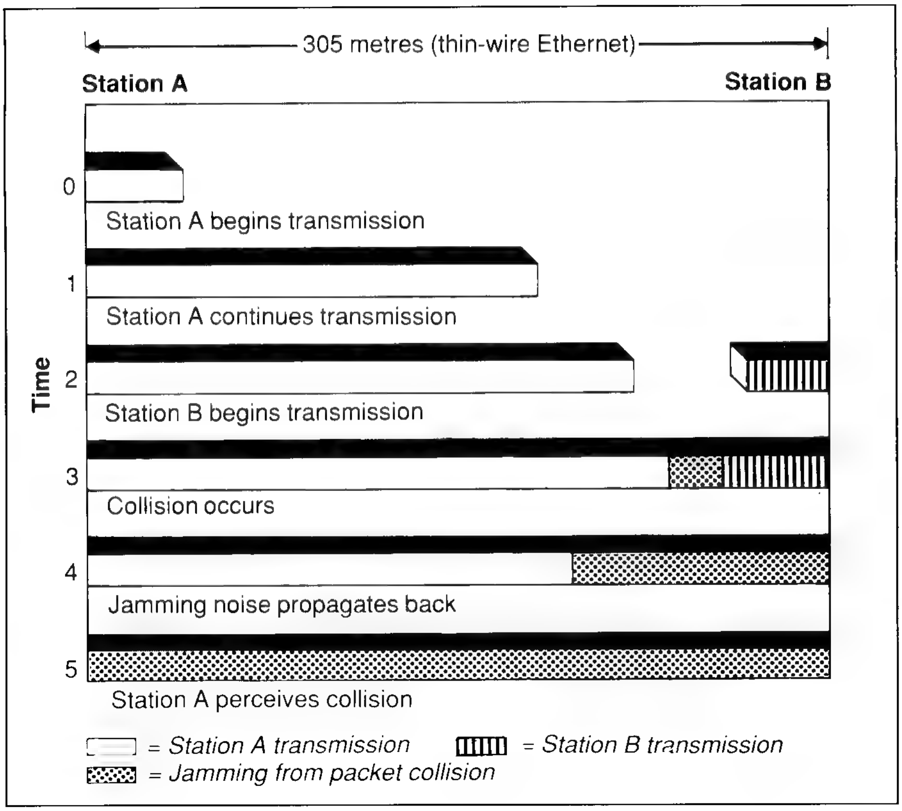

Fig 5 Ethernet packet collision. Sharing of the Ethernet bus depends on all stations being able to detect and recover from collision of packets. In this example, station A begins transmitting; then, Station B begins transmitting before A's packet has propagated down the bus

heavily loaded, stations dynamically adjust, attempting to transmit less often.

Collisions can occur only during an initial collision window, defined as twice the maximum network propagation delay. The size of this window is essentially the length of time it takes a transmitting station to detect a collision. Fig 5 illustrates a worst-case scenario — where stations A and B are as far apart on the network as is physically possible. A collision does not occur until the data packet from Station A has propagated down the network to station B. Station A must continue to transmit at least until the collision jamming noise propagates back over the network to it. Once the worst-case collision window has passed, any transmitting station will have seized the transmission channel and will not be interrupted until the entire packet has been sent.

Data is transmitted in packets of 8*n* bits, where 46 <=*n* <= 1500. The minimum size of 46 * 8 bits ensures that collisions are detected while transmission is in progress. Short messages are padded with binary zeros to the minimum length; longer data messages are broken into several packets. The data is sent using split phase encoding, a binary signalling method that combines data and clocking pulses. With this Manchester encoding technique, the first half of each data bit is at a voltage that is the inverse of the bit value, and the second half is the true value of the bit. Thus, each bit period always has one transition from a positive voltage through zero to negative, or vice versa. This transition forms a carrier that stations must listen for before beginning a transmission.

Packets comprise a synchronisation preamble, address fields, data fields, and a 32-bit frame check sequence CRC field. The preamble field is 64 bits, which allows enough time for the receiving hardware to stabilise and synchronise to the incoming bit stream. This field is immediately followed by the start frame delimiter (SFD) field. Address fields are 48 bits and identify the destination and source of the packet. A destination address of all binary 1s indicates a broadcast packet, which is to be received by all stations. Each network device has a unique address.

As data is sent over the network, all stations receive each transmitted packet, assembled and validated by the MAC layer of the network interface. Completed packets then travel upward to the LLC level, where the destination address is checked. Only when a station receives a packet with its address, or with a broadcast address, does the interface hardware pass the packet to the network station for further processing.

The data field of a packet is composed of a 16-bit length field and a maximum 12,000-bit data field. The length field counts the number of 8-bit fields (octets) that are present in the data field. If the data field size is less than 368 bits, it is padded with zeros. Full transparency is provided in the data field — that is, any arbitrary sequence of bits can be sent.

Ethernet implementations

An Ethernet-based LAN consists of one or more segments of coaxial cable arranged in a bus topology; the segment cable visits each network device, and only one path traverses the network. Ethernet cable segment can be as short as one metre or as long as 1000 metres. Ethernet networks can be implemented using either baseband or broadband.

Ethernet baseband networks use two different types of coaxial cable: thin (RG-58, 50 ohm), for trunk segments of less than 304 metres; and thick (RG-11, 50 ohm), which can be installed in lengths of up to 500 metres. Some vendors, such as 3Com, supply transceivers able to operate on thick coax segments up to 1000 metres in length.

Ethernet's thin wire was designed for office LANs. It can be ordered either in a variety of precut lengths with connectors installed or in bulk. Devices are attached to a thin-wire network via BNC T-connectors. A minimum distance of one metre is required between each station to control standing waves. Each end of the thin-wire segment must be terminated (electrically completed) by a BNC 50-ohm terminator. A maximum of 100 stations can be connected to a thin-wire segment. Fig 6 shows an example of a thin-wire Ethernet network.

The thick-wire version, sometimes referred to as 'backbone Ethernet', supports wider area networks; it can be used to tie together thin-wire networks. As in thin-wire implementations, the number of taps (device connections) and their spacing and length are limited by the need to control standing waves. Stations are connected to a thick wire via an external transceiver (Fig 6). The minimum distance be-

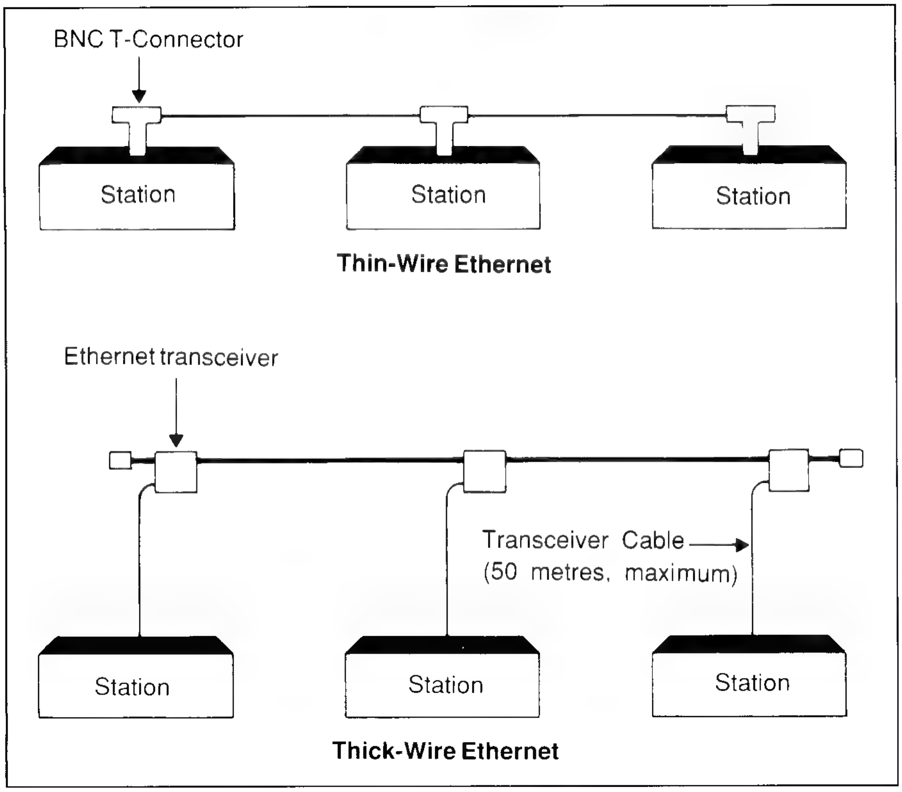

Fig 6 Ethernet configurations. In thin-wire Ethernet, a T-connector on the network interface card attaches the station to the bus. Thick-wire configurations use a tap and a short spur cable

tween transceivers is 2.5 metres; the maximum length of the cable connecting a device to a transceiver is 50 metres. A thick-wire segment can support up to 100 transceiver connections.

Thick and thin wire can work in combination in Ethernet implementations. In these combination networks the maximum segment length lies between the thick- and thin-wire maximums. The following formula calculates a maximum segment length (in metres) in a mixed media implementation:

Max_Segment = MIN(T+(E/3.28), 1000)

where T is the length of thin wire and E is the length of thick wire.

Ethernet networks can be extended with repeaters. A maximum of two repeaters is allowed in a path between any two network stations. A standard repeater has about the same delay as a 500-metre segment, because it must recover the clock for each packet and adjust gain controls. Repeaters are attached to the Ethernet wire via transceivers and can be placed on any permissible transceiver connection point. They contain logic to prevent the failure of a network segment from disabling the entire network; they do not repeat erroneous signals.

Repeaters that are connected by fibre optic cable are now available from some vendors. With this cable, the maximum distance between segments can reach beyond 1000 metres.

StarLAN implementations

StarLAN is AT&T's twisted-pair implementation of the CSMA/CD protocol. Even though StarLAN's 1-Mbps speed is slower than Ethernet's 10 Mbps, the ease of wiring the network outweighs most performance considerations, especially in small networks.

The wiring uses a four-pair modular cord that closely resembles normal modular telephone cable. However, standard four-pair modular telephone cables cannot be used without modification, because the pin configurations on the jacks are different.

StarLAN networks can be configured in a star topology, a daisy chain, or a combination of the two. StarLAN's daisy-chaining ability is an important advantage. Each device is linked in series to the next, with the Ethernet-equivalent T-connector integrated into the NIC. The output of one workstation card leads to an input on a second card (see Fig 7) The daisy-chained installation is appropriate for a network with 10 or fewer stations and with a maximum distance between the two ends of the cable measuring less than 122 metres.

A network that exceeds 122 metres must incorporate a star topology in which each device is cabled back to a central point, called the network extension unit (NEU). As many as 11 stations can be connected to a single NEU, each using up to 245 metres of cable. A network with more than 11 stations requires multiple NEUs, one of which must be configured as a master device with all others connected to it with 10 feet or less of cable. Secondary NEUs cannot be used to extend the geographic span of a StarLAN network.

StarLAN is flexible enough to allow both a daisy chain and star topology in the same network. As Fig 7 shows, daisy chains composed of 2 to 10 stations can be cabled back to a single NEU port. The maximum distance allowed from a particular daisy chain to the NEU is as follows (in metres):

Stations	Distance
2-5	245
6	225
7	190
8	170
9	140
10	125

The distance can be extended with a network interface module connecting the StarLAN network to AT&T's information systems network (ISN) data switch. ISN supports a variety of connections at distances of up to a few thousand metres (depending on wiring), but the necessary protocol conversion is not supported by all network software, such as Novell's NetWare.

Token-passing buses

Installing a network in a factory requires a great deal of flexibility in topology — in cable lengths and the ability to use trees and stars, with repeaters. The network must be extremely reliable and have an upper bound on response time. The token-passing bus helps meet these objectives. The manufacturing automation protocol (MAP), implements a token-passing bus; its basic concepts also are used in ARCnet networks. The IEEE 802.4 standard defines a token bus that can be implemented in baseband, broadband, and hybrid applications. The bus behaves similarly to the token ring in that its algorithm passes the token in a sequential manner from station to station.

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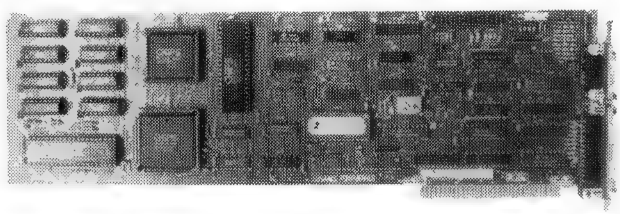

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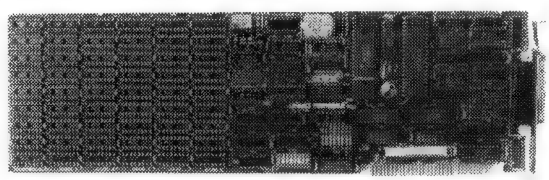

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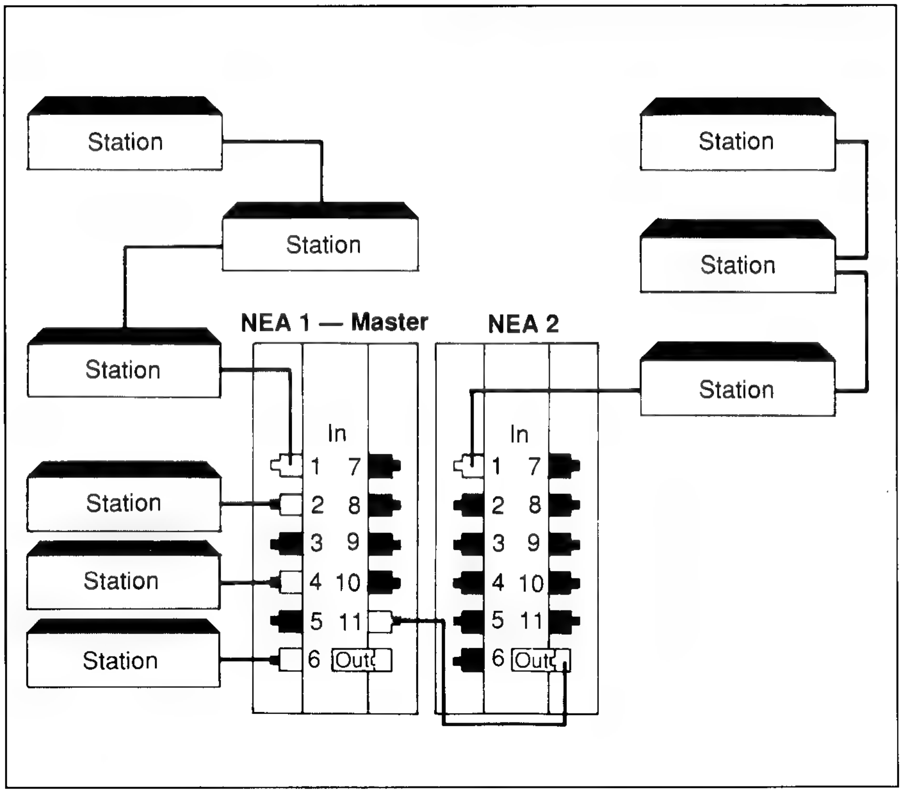

Fig 7 StarLAN configurations. In small StarLAN networks, stations can be daisy-chained; larger networks must use a star coupler to extend capacity. Both methods can be used in a single network

A token bus behaves logically as a ring network, as shown in Fig 8. After a station has completed transmitting any data frames, the station sends a token MAC frame to its successor. It listens for evidence that the successor has heard the frame and is active. If the token sender does not hear a valid frame, it listens for up to four time slots and then retransmits. If the successor still does not transmit a valid token frame, it assumes the successor failed. The sender then transmits a 'who follows' frame that queries all stations, asking who follows the specified address of the failing successor. This allows the sender to establish a new successor and continue passing the token.

Response windows allow new stations to enter the logical ring. Special solicit successor frames specify a range of open station addresses, to which an entering station responds if its address is within the range. The soliciting station must establish a new successor if one responds. Like the token-ring protocol, priority bits can be used to bypass stations with low priority frames.

Three media and transmission methods are included in standard 802.4. The 1-Mbps version uses an omnidirectional bus and 75-ohm coaxial cable, such as RG-6, RG-11, and semirigid (CATV). Drop cables are 25- to 50-ohm stubs, less than 350 millimetres long. A long, unbranched trunk cable with very short stubs is recommended. Active regenerative repeaters can be used for branching and extension of the system. Signalling is by Manchester encoding.

A 5 and 10-Mbps baseband version also uses an omnidirectional bus and 75-ohm cable, with very short drops. Semirigid cable with RG-6 drops is recommended. Active repeaters are used for branching the bus and extensions of the cable. Signalling is by frequency shift keying (FSK) with direct encoding of data and non-data symbols at particular frequency shifts.

The broadband version uses CATV-like semirigid trunk cable and flexible drops. Standard CATV amplifiers are used, with head-end regenerative repeaters that provide the clock signal. Speeds of 1, 5, and 10 Mbps are supported in broadband channels of 1.5, 6, and 12MHz, respectively. Signalling is by amplitude modulation of the radio frequency signal, with three levels: zero, non-data, and one. The non-data level is used to ensure synchronisation.

ARCnet

Although Datapoint's ARCnet is related to the 802.4 token-passing bus standard, it predates that standard and thus does not strictly conform. Unlike the IEEE standards, ARCnet is a result of informal cooperation by many manufacturers. The ARCnet standard is followed so closely by these companies that a network can be set up with different cards, all communicating transparently.

A distributed star architecture, similar to StarLAN, is used to implement the bus, which runs at 2.5 Mbps. ARCnet is limited by being able to send only single packets of 508 bytes. Novell NetWare sends 560-byte read and write packets to its file server, so an ARCnet system must send two packets, with the second requiring an additional token cycle. The positive acknowledgement of the token system keeps an upper bound on response time, however.

ARCnet stars are centred with active and passive hubs. A passive hub has four connectors for up to four workstations in a simple network, or it connects three to an active hub. An active hub conditions, boosts, and relays the signal to stations, passive hubs, or other active hubs. It has eight connectors.

An ARCnet network must not exceed 6000 metres. The maximum distance between an active hub and a network station or another active hub is 600 metres. The maximum distance between an active hub and a passive hub is 30 metres, as is the maximum distance between a passive hub and a network station. Passive hubs cannot be directly connected, and no loops are allowed. The cable is RG-62 93-ohm coax, with BNC connectors.

Token-ring access

After several experimental implementations of the token-ring access method, Prime Computer and Apollo in the US began selling such networks in the early 1980s. Meanwhile, IBM issued several statements of direction and published its wiring plan with token ring in mind, then announced a version to network PCs as the first implementation. IBM's network has now been extended to link an IBM 3725 mainframe communications controller to a PC, to allow the PC to function as a terminal or gateway.

The existence of a non-proprietary standard, combined with IBM's support, has made IEEE's 802.5 a very popular protocol. Many vendors offer

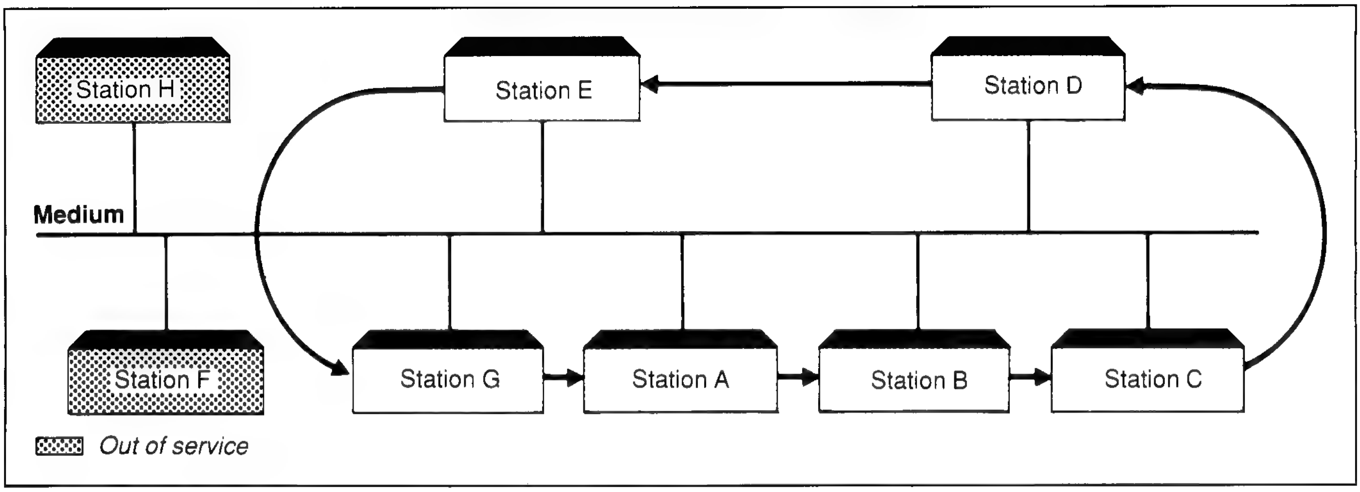

Fig 8 Token-passing bus. A token bus behaves logically like a token ring. An assigned sequence determines the order in which stations access the bus

products that are compatible with 802.5, including 3Com and Ungermann-Bass.

A token ring consists of a set of workstations connected by a cable in which data is transmitted sequentially from one station to the next; the receiving station is responsible for repeating and regenerating the signal to the next station in the ring. The station whose address matches the destination address field in the packet copies the information as it passes and processes it according to the MAC functions of layer 2 in 802.5. The address station also passes the information to the next station on the ring; the station that transmitted the packet finally removes it from the ring.

A station is authorised to transmit when it detects a token. When a station captures the token, it can modify it to make a frame, consisting of the start-of-frame sequence, control and status fields, address fields, information fields, the frame check sequence, and the end-of-frame sequence. After this new frame is created, the sending station initiates a new token, which allows other stations around the ring to access it. A token-holding timer controls the maximum amount of time a station can use the medium, either transmitting a new frame or not, before passing the token.

The 802.5 standard includes a system of priorities, determined by the type of message, such as synchronous, asynchronous, and immediate (network recovery). The present IBM token-ring implementation for PCs does not support priorities, however.

The protocol used for initialising a token ring and recovering from hard errors defines a complex, five-state, finite state heuristic machine. The 802.5 standard includes a protocol for failure domain identification that notifies all stations farther around the ring of a failure. This may not allow the network to heal itself, but an error message could help pinpoint the failure.

IBM's Token-Ring

In its Token-Ring Network, IBM allows two types of cable: a shielded twisted pair (types 1, 2, and 9) and unshielded telephone-style wire (type 3). The IBM type 1 cable allows more reliable communications and has longer distance allowances than type 3.

'Followers of these standards are also unlikely to find themselves in possession of orphaned technology; the same cannot be said for networks proprietary to one vendor.'

A maximum of 260 devices can be connected on a ring, including 33 IBM Multi-station Access Units (MAU). All cables (or lobes) from the distribution panel containing the MAU to the workstations must be less than 100 metres, with some exceptions if the overall network is small. For a permanent installation, IBM recommends a rack in each wire closet into which cables to all possible stations terminate on IBM cabling system connectors. Short lengths of type-1 cable are used to patch the rack connectors to the MAU.

IBM provides charts to compute the allowable lengths of various segments in its Token-Ring Network. The longest segments are possible when all MAUs are in the same wiring closet. The IBM Copper Repeater allows a ring to cover a larger area, up to 775 metres in a very simple network. Optical fibre repeaters also can be used to extend lengths and to link buildings that have ground potential differences or high electromagnetic interference. Optical fibre repeaters extend the distance in increments of two kilometres for each IBM repeater.

Cabling options

In the past, cable media types — coax, twisted pair, etc — were wedded to specific network protocols. For example, 802.3 systems were available on only two varieties of coax. This will not be true in the long run. The industry is evolving to media-independent implementations of the major IEEE network standards. 3Com recently announced support of unshielded twisted-pair wiring for its 10-Mbps Ethernet system, and IBM supports three types of media on its Token-Ring Network.

Normal telephone grade twisted-pair wiring is becoming the de facto standard for small departmental LANs. This cable is inexpensive and easy to work with. In many cases extra pairs of existing telephone wire can be used to implement a small LAN with minimal cost.

For larger networks — involving multi-

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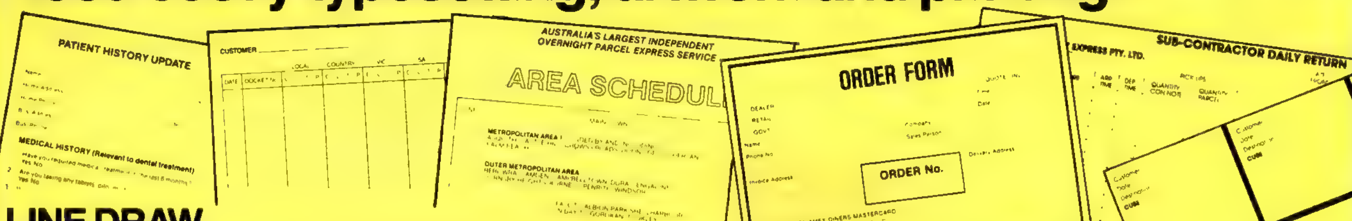

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critical can be successfully implemented on CSMA/CD systems. The lower installation costs of StarLAN networks make it an ideal choice for small networks.

Under heavy loads, however, token networks provide better performance. A major advantage of token systems is that a station response is deterministic — a known upper bound is set for the amount of time a station must wait before transmitting. In contrast, station delay time in CSMA/CD can be expressed only statistically; in the worst case, because every attempt to transmit can potentially cause a collision, a station may be blocked indefinitely.

Token architectures allow a critical station to be given priority access to the media. In addition, token systems do not impose minimum packet size requirements as CSMA/CD does. The principal disadvantage of token networks is their complexity, such as the fault recovery or ring initialisation procedures. Also, they exhibit a fair amount of overhead, especially under lightly loaded conditions.

Regardless of the choice of LAN technology, the benefits of opting for one of the standards presented here are overriding. Support from multiple vendors creates competition, which leads to product improvements and better value per dollar. Followers of these standards are also unlikely to find themselves in possession of orphaned technology; the same cannot be said for networks proprietary to one vendor.

The widespread support of hardware standards leads LAN software vendors to provide operating systems that run on standard networks. For example, Novell's NetWare supports ARCnet and all of the 802 standards; 3Com's 3Plus supports Ethernet and IBM's Token-Ring. In contrast, IBM's PC LAN operates only on the Token-Ring and IBM's proprietary networks. By selecting a LAN operating system that supports multiple standards, it is possible to use identical software across multiple LANs, yet still be able to choose the most appropriate LAN hardware.

As evidenced by the vendor implementations discussed here, there is considerable room for innovation within the bounds of these standards; the use of the 802.5 standard as the foundation for FDDI is one example. Although standards can sometimes be faulted for locking in the technology of the past, the IEEE standards are flexible enough to serve into the future.

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U6. DIRECTORY LISTER. Creates directory lists for comments. Saves to disk

U7. DIRECTORY PATHS. Lets programmes write to other directories.

U8. KEYBOARD DEFINER. Redefines keyboard to suit own needs.

U9. SPACE. Shows the amount of free space on disk in thermometer style.

U10. SUPERIOR DIRECTORY Shows disk directory with file attributes which are active. Also sorts by name, date, size, extension. Accurate for hard disk.

U11. BACKED UP. Indicates which hard disk files have not been backed-up.

U12. NEW FILES. Lists files that you created today.

U13. SPEEDKEY. Increase speed of cursor.

FILE PRINTING/EDITING

U101. PRINTER SWAP. Swaps line printer assignments for easier printing.

U102. WORDSTAR CONVERTER. Superior converter of wordstar to ASCII and reverse from document file.

U103. DISK COVER DIRECTORY. Prints directory in size suitable for pasting on disk jacket.

U104. COMMAND EDITOR. Very good editor of operating system commands.

U105. BANNER. Prints wide banners on your printer.

U106. LISTER. Prints documentation, adding page numbers.

U107. PRINT CONTROLLER. Gives extensive control of printer settings – bold, italics, compressed, etc. Epson compatible.

U108. NOT PRINT. Redirects computer output to the screen.

U109. DARKEN. Overstrikes a text file to obtain darker print.

U110. MERGE. Merge sorted files into one sorted file.

U111. TEXT FORMATTER. Processes text files for printing with special features imbedded in output – bold, italics, etc.

U112. SEARCH/REPLACE. Search for and replace characters.

U113. CUT & PASTE. Allows movement of parts of documents between files.

U113. NOTEPAD. Ready at hand notepad. Memory resident.

U114. TEXT INDEX. Indexing for text files Mark words for listing.

U115. WORDSTAR INDEX. Indexing system for Wordstar.

U116. UNDERLINE STRIPPER. Strip underline from Wordstar files.

U117. KEYBOARD DEFINER. Key board redefiner for Wordstar.

U118. WORDSTAR COLOUR. Adds colour to Wordstar

U119. WORDSTAR NUMBERS. Add and remove numbers to paragraphs in Wordstar files.

U120. WORDSTAR CHARACTERS. Character look up programme.

U121. EXECUTABLE PATCHES. Standalone Wordstar patches

U122. WORDSTAR GREEK. Obtain Greek characters in Wordstar documents.

U123. PROGRAMME EDITOR. Editor for programmers, with multiple windows.

U124. TEXT EDITOR. Editor with major commands, without frills.

U125. LAST LINES. Types the last specified number of lines in a file.

U126. FAST LISTING. Fast listing of files by extension.

U127. SQUEEZE LIST. Lists squeezed library files.

U128. COUNT. Counts characters, words, lines, pages in a textfile.

U129. PRINTER PATCHES. Extensive collection of printer patches for wordstar.

FILE LOCATING

U201. SMALL FILE FINDER. Locates files in subdirectories. Small tightly coded.

U203. FILE SEARCH. Memory-resident. Locates files in subdirectories.

U204. CHARACTER SEARCH Searches disk for character or string.

U205. FILE FINDER. Locates and lists files, allows deletion of unwanted files. Act from within programme.

U206. NEW GREP. Matches file patterns. Has 'C' source.

FILE READING/DISPLAY

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U303. READ BACKUPS. Read backup disks of your hard disk. Needs Basic.

U304. TREE DIRECTORY. Displays a tree directory of files, including sub-directories.

U305. TRACK READER. Reads sectors and tracks in hex and ASCII.

U306. BROWSE. Examine files with 4 way scrolling.

U307. DUMP. Gives an ASCII/HEX display of any file.

U308. DIRECTORY READER. Read a directory from or to a certain point.

U309. KEYBOARD BUFFER. Keyboard buffer of 160 characters.

U310. SYSTEM SHELL. Operating system shell that interfaces with Crosstalk, 1-2-3, and Multimate.

EQUIPMENT HANDLING

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U402. CORELOOK. Gives memory content in HEX and ASCII.

U403. SCREEN SAVE. Blanks screen if not used for several minutes. Saves screen wear.

U404. DISKPARK. Positions the hard disk head key for safety when travelling or moving computer.

U405. COLOUR CONVERTER. Displays colours as shades of grey.

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U502. REDIRECTS output to a disk file.

U503 NIMBLE DISK. Helps you move more easily around a hard disk.

U504. SECTOR RETURN. Recovers deleted first sectors.

U505. SELECTIVE COPYING. Copy programme using menu system.

U506. SELECTIVE DELETION Programme delete using menu system.

U507. ENHANCED COPYING. Copy several unrelated programmes with the same command.

U508. NEW MOVE. Rename and move programme to another directory without copying.

U509. TOTAL ERASURE. Totally erases disk, including format.

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U602. FILE CORRUPTION. Fast checker for detecting corrupted files.

U603 DISK SQUEEZE/UNSQUEEZE Squeezes and unsqueezes all files on a disk.

U604. PROTECT/UNPROTECT. Avoids accidental erasure of important files..

U605. SECRET FILES. Make, go to, or remove a secret directory.

U606. SQUEEZE/UNSQUEEZE. Compresses files to save space. Also uncompresses.

U607 LIBRARY CREATOR. Combines files into libraries. Adds to, deletes, extracts files.

U608. LIBRARY DISPLAY. Displays the directory of a library. Related to above programme.

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U705. ALARM. Sets time for alarm to sound.

U706. NEW TIME. Sets system time and clock.

U707. DOS HELP. Assistance with dos commands displayed on screen.

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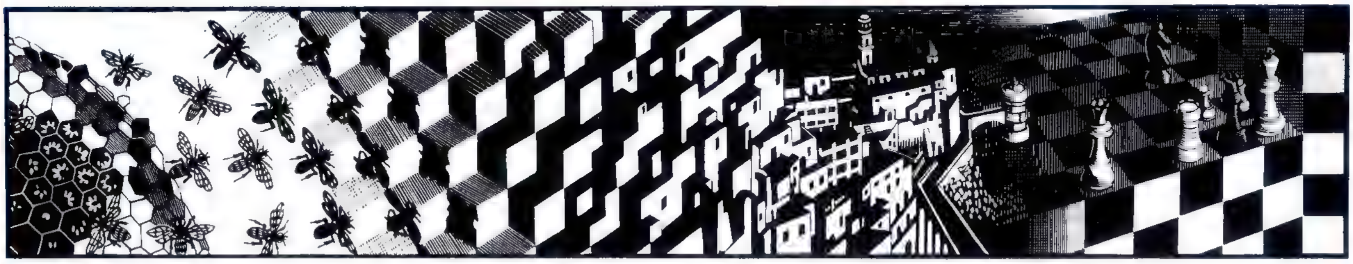
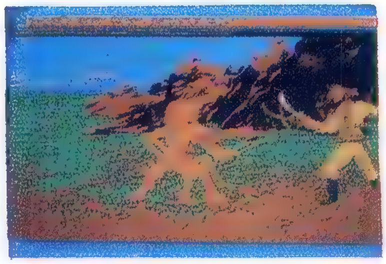
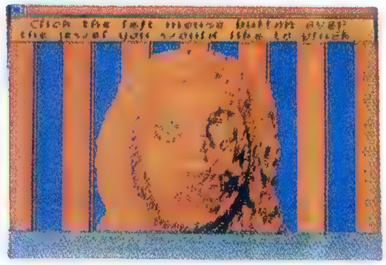


Not content with striking it lucky at the bowling alley, Stephen Applebaum saves the throne from unscrupulous usurpers in Damaron — all in this month's Screenplay.





Going out in style

Title: Sinbad and the throne of the Falcon
Computer: Amiga
Supplier: Imagineering
Price: $79

Sinbad and the throne of the Falcon is the fourth — and sadly last — title in Master Designer Software's glittering Cinemaware series; a project that began with Defender of the Crown and then looked doomed to failure with the launch of the dreadful Reagan-pandering SDI. But, as The King of Chicago, reviewed in last month's Screenplay, showed, SDI was — thank goodness — just a momentary aberration.

If the Cinemaware project started on a high note, then it finishes on an even higher one: Sinbad and the throne of the Falcon is by far the best of the four games. Not even Defender of the Crown can escape the shadow cast by this one.

The game's scenario centres around the ailing Caliph of Damaron who, days before announcing his successor, is magically transformed into a falcon. Rulerless, Damaron falls into a state of confusion.

In the mountains and meads beyond the city walls, Black Prince Camaral, the disinherited son of the Caliph, orders his armies to attack the palace and make the throne his. But it isn't only Camaral who sees the Caliph's misfortunes as his victory. In a small village near Damaron, Libitina (whom the Caliph divorced, saying she was a witch) prepares her son, Jamoul, for Royal office.

Back in Damaron, Princess Sylphani and Prince Harun, the man thought to have been the Caliph's choice of successor, await the arrival of Sinbad, their only hope against the evil threatening Damaron from all quarters.

Your role in all of this is, of course, that of the heroic Captain Sinbad. With the aid of your 'willing' crew and those whom you can press into service, you must sail the world in search of the spell that will release the Caliph from his affliction and bring peace to Damaron once again. Until that time, you must also command the Caliph's armies against the forces of Black Prince Camaral.

Sinbad and the throne of the Falcon is played by alternating between three control screens, each one of which provides information of different aspects of the adventure.

The Time screen displays an instrument rather like an hour glass, indicating the time you have left to find a cure for the Caliph. Should you fail to beat the rush of sand, the Caliph will be doomed to live out the rest of his days as a falcon.

Of the three control screens, the most ingenious is one featuring a topographical map of the mythical world where the adventure takes place. Pressing the left-hand mouse button when this screen is selected produces a large magnifying glass which you can guide over the map to reveal the names of the seas, towns and islands. You must know these, as the only way of moving around the world is by selecting the name of your destination from a pull-down menu called 'Move To'; the contents of which change, depending on your current location.

The final screen is called 'The City'; and features a close-up view of Damaron and its environs. Again the scene shows only the geographical features of the land, though in this case names are not important. What is, is the meshwork of hexagons drawn over the background.

Each hexagon on The City map represents a space into which you can move an army. Your armies — or rather, those loyal to Caliph — are shown in red, while Camaral's are black.

When you point to an army with the mouse cursor, a status line along the top of the screen informs you of its size and mobility. Weak armies, severely depleted through battle, can be moved into one of six special hexagons designated as supply centres. Any army, whether it be one of yours or the Prince's, reaching a supply centre, is almost immediately reinforced back to full strength.

Throughout the game, help can be gleaned from the Princess Sylphani, a shaman, a genie, Prince Harun, a gypsy named Iris, and even the seductress, Libitina.

When you meet a character with whom you can converse, the display changes to show a small, animated representation of that person. In each case, speech bubbles filled with questions puff from their mouths, and you have to answer by selecting the most appropriate reply from a list stored in a

pull-down menu. Most of these contacts are fairly uneventful, though the one with Libitina is rather interesting, to say the least.

Many of the islands on which you land are inhabited either by Camaral's armies or a ferocious creature such as a black panther or a lion. An encounter with one of these invariably means having to let your sword do the talking.

Sword fights are brilliantly 'staged', with the antagonists represented as large, animated figures which cut and thrust with deadly precision. Fights such as these are waged until one of the characters' strength falls to zero, as represented by a bar along the top of the screen. During a fight, hits with the sword result in a spurt of blood and groaning issuing from the victim, if it is a human. Panthers and lions roar with menacing realism, while a skeleton, who appears every now and then, rattles.

As if swordfights weren't enough, storms often blow up unexpectedly at sea, and you find yourself having to guide your ship around gigantic pillars of rock while boiling seas toss you from side to side.

Each scene in Sinbad and the throne of the Falcon are superbly depicted with some quite stunning artwork. One of the most beautiful scenes is of your ship at dusk, its sails billowing in the breeze. Add to sights like this the atmospheric soundtrack that changes with your location, and you have a game to challenge anything on the market at the moment.

If this really is the last Cinemaware game, Master Designer Software could not have chosen a program with more lasting impact to finish off its incredible series.

Strike it lucky

Title: 10th Frame
Computer: C-64, Amstrad
Supplier: Imagineering
Price: $28.40 (cassette), $38.60 (disk)

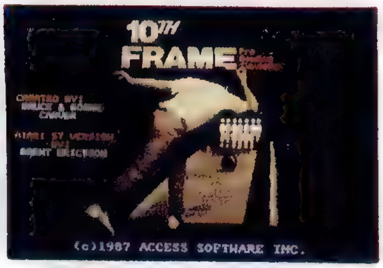
American software house Access has earned itself a reputation for producing high-quality sports simulations. One of its most successful titles, a golf game called Leaderboard, is a fine example of the genre and one of the best in its field. And now 10th Frame, a 'pro bowling simulator' and the company's latest foray into the sporting milieu, looks set to become not only a massive success but also a classic of its kind.

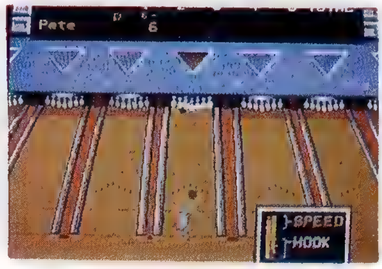
Whereas Leaderboard is a highly stylised representation of golf, 10th Frame is very much a straightforward simulation of ten-pin bowling. In fact, Access' programmers have gone out of their way to make the game as realistic as possible, even as far as digitising the sounds from a real bowling alley.

A game of 10th Frame can be contested by up to eight individual players in Open mode, or two teams of four in League mode. In both modes, players can select their skill levels from Kids, Amateur and Professional.

During play, the display features a three-dimensional view of what you would see if you were standing on a balcony directly behind the lane where the game is being played: in the foreground stands the bowler, while the skittles, or pins, are arranged in the form of a triange near the top of the screen. Above everything else, in a rectangular box located along the top of the display, is the current player's scorecard.

Thankfully, the computer takes care of all the scoring. But for all those diehards who like to keep their own scores, Access has included a brief resume of the rules in the game's playing instructions (which is lucky, as the





method of scoring in ten-pin bowling is odd, probably due to its American provenance).

When setting up a shot in 10th Frame, you must position both the bowler and his mark. The mark is a small yellow square that can be moved from left to right across the lane and denotes the direction the ball will roll in when the bowler releases it from his grip. Where you position the bowler depends on the amount of 'hook' you intend to apply to the ball.

The method used for bowling is rather like that employed in Leaderboard Golf and, similarly, consists of three phases, all of which are monitored on a speed/hook meter in the bottom right-hand corner of the display. The speed/hook meter consists of two vertical bars side by side, each with a small graduated section at one of its extremities. Speed is indicated on the left-hand bar, while the amount of hook applied to the ball is shown on the right one.

To start the bowler off on his run-up, you first press and hold down the left-hand mouse button. As he runs forward, a yellow indicator rises up the speed bar. When it reaches the small, graduated section near the top, you release the button, thus setting the ball's maximum speed. You must release the mouse button at just the right point along the graduated section, otherwise the ball will be released at too high or too low a speed, incurring a direction error.

Releasing the mouse button causes a yellow indicator to run down the hook bar. This time, you must press the mouse button when the indicator reaches the graduated section or so-called hook zone. Timing is all important here, as giving the ball too great a hook will send it careering off into the left-hand gully.

As the ball trundles off down the lane, it does so to the sound of a real ball recorded at a bowling alley. Having finally been hit, the pins fly off in all directions. Some spin, some teeter, while others hurtle off into the trough at the very end of the lane.

After all the players in a game have finished their current round of frames (two bowls), a large score sheet 'drops' from the top of the display to reveal the scores of each player. This may be output to a printer at the end of a game, if you wish.

There is very little that can be faulted in 10th Frame, except that it becomes a little too easy when you get the hang of aiming the ball and using the speed/hook indicator. Although I don't think it will lose its appeal for groups of players, it can become rather monotonous if you are playing on your own. That said, there is no ten-pin bowling simulation to better it at present.

END

Looking just like 1-2-3

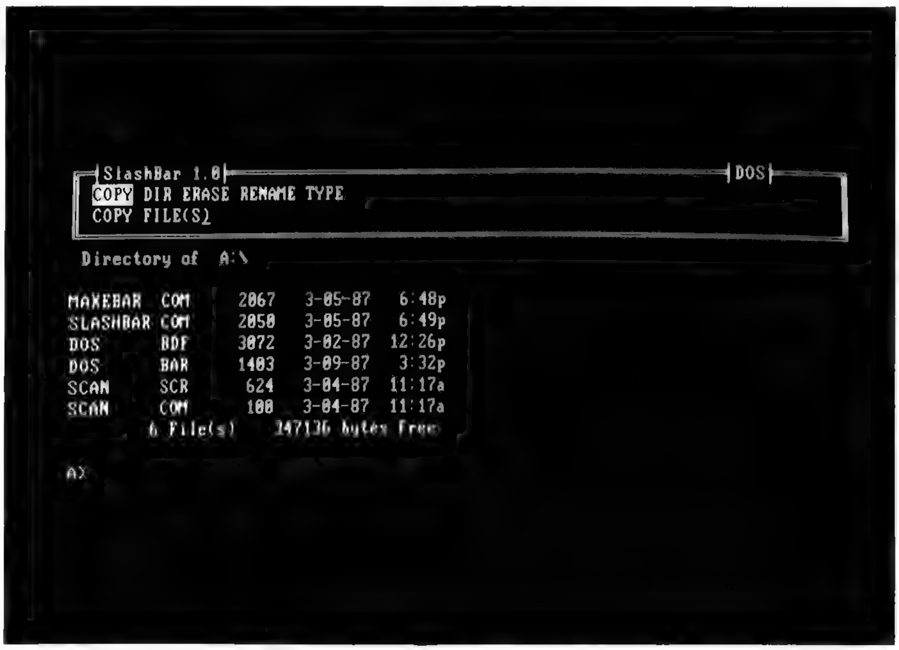
In last month's issue you saw how to design 1-2-3-style menus for your IBM PC applications. Here's the standard pop-up interface that runs them all.

If you ever doubt the creative imagination of PC software developers, just consider the number of different ways they have found for moving a block of text from one place in a file to another. Some programs do it with a command syntax so cryptic that it makes cult loyalists of the few who can master it. Other, user-friendly programs have more menus than a restaurant chain — but won't stop proffering them long after you've learned what you want.

If there's any good news in all this, it's that out of the chaos one interface seems to be emerging as a de facto standard: the slash-bar interface, as used in Lotus's 1-2-3. The slash-bar has been widely imitated because of its simplicity, ease of use, and adaptability to almost any type of program. But if your favourite application didn't come with a slash-bar interface, you've been stuck — until now. The SLASHBAR program presented here is a memory-resident utility that allows a slash-bar interface to be superimposed on almost any application.

In the background, but always available, SLASHBAR is ready to pop up and display a menu of your design. (Last month's article shows you how to make suitable .BAR files for SLASHBAR.) Common commands that may have required many keystrokes to execute previously can now be selected quickly by the point-and-shoot method. Novice users can search the menus for the correct command and use the Esc key to back out at any time. And since the original program interface remains unmodified, power users can work as they always have.

If you choose, you can design a SLASHBAR menu for each of your application programs, putting a common interface on very dissimilar programs. You'll be able to move from spreadsheet to database to word processor, retaining the identical command interface. If there's been a program you've wanted to use but didn't want to learn, design the menu once, and then there's no need to remember control-key or function-key codes. Think of the advantages of teaching novices the interface instead of the program. See one program and you'll have seen them all.



A screen shot of the second-level DOS.BAR menu, called up over a directory listing

Getting SLASHBAR

The easiest way to get your own copy of SLASHBAR is to download it via modem from Microtex on Telecom's Viatel (page *6663#) or by sending a stamped self addressed package containing a blank formatted disk to the attention of Jean at APC, 124 Castlereagh Street, Sydney 2000. She'll return it with SLASHBAR along with MAKEBAR and last month's example file DOS.BDF. If you prefer to type the listing in yourself, the assembly language source code is shown in Fig 1, and a Basic program that will create SLASHBAR.COM when you run it once is shown in Fig 2.

Before you can use SLASHBAR.COM, however, remember that it is only one of two parts that make up this memory-resident utility. The SLASHBAR.COM file contains all the logic needed to pop up a menu window on the screen and interpret replies. The second part of the utility is the

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specific bar-menu file you must create for each application. The bar-menu file contains the choices and instructions needed to operate the application program through the SLASHBAR interface. Complete instructions and examples for creating the menus are given in last month's issue. In this discussion, I'll use the same sample DOS menu presented in that article.

Once you have both SLASHBAR.COM and a suitable menu, you execute the program at the DOS prompt by entering the command

SLASHBAR [path]menuname.ext [/n]

where *menuname.ext* is the name of the compiled bar-menu file (which usually has a .BAR extension), and the /n parameter is used to reserve enough memory, in bytes, when the program first loads for the largest .BAR file you intend to use. If no /n parameter is specified, SLASHBAR will set aside a 4096-byte buffer. The upper limit for n is approximately 60k, which is more than the largest .BAR file that can be produced by the MAKEBAR compiler. If you attempt to load a file that is larger than the current SLASHBAR buffer, an error message will be displayed.

When SLASHBAR is executed the first time, it becomes memory resident and decreases the available memory. The .BAR file specified on the command line is loaded into the program buffer and is displayed when the menu is activated. Executing SLASHBAR again, with a different .BAR file, will copy the new file into the buffer of the resident copy. SLASHBAR checks to see if it is already resident, and may be executed as many times as you desire without using additional memory.

Once SLASHBAR is loaded, pressing the Alt-Slash key (/) key combination will pop up a two-line menu window on the screen. The accompanying screen shot shows what the second level looks like for the DOS.BAR menu. The name given to menu appears in the window border on the far right. This reminder helps ensure that the menu that is loaded matches the current application. All available options are listed on the first line in the menu, with the current choice displayed in reverse video on a monochrome monitor, or in distinct colours on a colour monitor. Below the options, a help line is displayed for the current menu selection.

Menu options can be selected in two ways. The reverse video cursor bar may be moved using the Home, End, Right Arrow, and Left Arrow keys until the cursor bar is on the desired menu selection. As each option is highlighted, the help line changes to explain that selection. Pressing Enter will then cause the current menu option to be executed. This method is helpful while trying to learn a new application or searching for a forgotten command.

As your proficiency grows, however, the point-and-shoot interface tends to become tedious. Lest what was once helpful becomes a hindrance, the SLASHBAR interface allows an alternative way to select menu options. Simply by pressing the first letter of the desired menu option, that option will be selected and executed immediately. The effect is exactly the same as if you had selected the option with the video bar and pressed Enter.

Movement along the menu tree is usually one-way. As options are selected, you proceed down the tree until you find the command to be executed. If you select the wrong option, however, or make a mistake while entering text, the Escape key allows you to 'back out'. Pressing Esc repeatedly will eventually bring you back to the top level and close the window.

SLASHBAR is a well-behaved resident program and should be compatible with most other resident programs. It will work with any applications program that uses the BIOS interrupt 16h to retrieve keystrokes. Applications that handle the keyboard directly will not be usable with SLASHBAR. Because it places keystrokes directly into the keyboard buffer, other programs that act similarly may cause a conflict.

Patching the hot key

Many applications make extensive use of the keyboard and leave few key combinations unused. If one of your applications uses the Alt-Slash key combination, you can patch SLASHBAR.COM to use the 'hot key' of your choice. At the beginning of the assembly language listing for SLASHBAR (Fig 1) there are two equates, labelled HOTKEY and SHIFT_MASK. Changing these equates and reassembling (use the Microsoft or IBM Macro Assembler, Version 2.0 or later) will produce a new version of SLASHBAR that uses your designated hotkey. If you don't have an assembler, you can path the .COM file directly with DEBUG, using the following instructions.

The value used for HOTKEY is the 'make-scan code' of the key that is reported by INT 9. This code can be determined by simply looking it up in the accompanying table 'Keyboard Scan Codes for Alternative Hot Keys'.

The second part of the hot-key modification involves the shift status. There are four 'shift' keys: Alt, Ctrl, Left Shift, and Right Shift. (The IBM Enhanced Keyboard has two Alt and Ctrl

```
;=======================================================================
;  SLASHBAR is a memory resident interpreter for files prepared by the
;  MAKEBAR utility.  Bar-menu Description Files (.BDF) are first prepared
;  to contain the keystrokes and prompts needed to perform the functions.
;  The .BDF file is then or compiled to a BAR file.  This
;  file is loaded on the command line.
;
;  Usage:  SLASHBAR  [path\]menuname [/n]
;        where /n is the size buffer to allocate.  /n is only valid for the
;        first load and is specified in bytes.  For obvious reasons it
;        should be as large as the largest .BAR file you will use < 60K.
;-----------------------------------------------------------------------
LO_MEM  SEGMENT AT 0000H
                ORG     41AH
BIOS_HEAD       DW      ?
BIOS_TAIL       DW      ?
BIOS_BUF        DW      16 DUP (?)

LO_MEM  ENDS

;=======================================================================
CSEG    SEGMENT PARA    PUBLIC  'CODE'
                ORG     100H                    ;COM file format
STACK           LABEL   WORD                    ;Use PSP as stack when res.

                ASSUME CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG

;-----------------------------------------------------------------------
;  Equates - substituted literally when assembled.
;-----------------------------------------------------------------------
```

```
CR              EQU     0DH                     ;HEX for carriage return
LF              EQU     0AH                     ; and line feed
                                                ;ALT-RIGHT SHIFT-TILDE
HOTKEY          EQU     35H                     ;SCAN code activating key
SHIFT_MASK      EQU     08H                     ;Mask to pick out 'shifts'
                                                ;1000 = ALT     0100 = CTRL
                                                ;0010 = L.SHIFT 0001 = R SHIFT

NROW            EQU     4                       ;Number of rows in the window
NCOL            EQU     80                      ;Number of cols in the window
BOX_COL         EQU     0                       ;Left col of window on screen
BOX_ROW         EQU     0                       ;Top of screen
BW_ATTR         EQU     7007H                   ;Monochrome window
CO_ATTR         EQU     0417H                   ;Color window

SPACE           EQU     20H                     ;Equivalents for some keys
ESC_KEY         EQU     1BH
BS_KEY          EQU     08H
TAB_KEY         EQU     09H
RIGHT_ARROW     EQU     4DH
LEFT_ARROW      EQU     4BH
HOME_KEY        EQU     47H
END_KEY         EQU     4FH

MAX_CMD_VAL     EQU     10                      ;Use for error checking
;-----------------------------------------------------------------------
;  COM file entry point is at 100h
;-----------------------------------------------------------------------
```

Fig 1 The assembly language source code for SLASHBAR.COM

```
ENTPT:          JMP     INITIALIZE              ;Perform initialization

COPYRIGHT  DB   "SlashBar 1.0 (c) 1987, Ziff-Davis Publishing Corp."
           DB   CR,LF,"$",1AH
           DB   "Robert L. Hummel"

;------------------------------------------------------------------------
;  Data used by INT_9 procedure.  Other data precedes other procedures.
;------------------------------------------------------------------------
OLD_INT_9       DD      0                       ;Storage for old vectors
OLD_INT_16      DD      0
OLD_INT_21      DD      0
DOS_FLAG        DD      0                       ;Address of dos critical flag

ACTIVE          DB      0                       ;Inside pop-up
LO_FN_FLAG      DB      0                       ;When inside Int 21h

DISPLAY_PAGE    DB      0                       ;Used by screen save
CURSOR_POS      DW      0                       ; to restore info

OLD_SS          DW      0                       ;To save stack
OLD_SP          DW      0                       ; during switching

;========================================================================
;  New Interrupt 9 routine. Invoked each key-press.
;  Test to see if our key combination has been typed.
;------------------------------------------------------------------------
INT_9           PROC    FAR
                ASSUME  CS:CSEG, DS:NOTHING, ES:NOTHING, SS:NOTHING
                                                ;(Flags saved by INT)
                STI                             ;Allow interrupts
                PUSH    AX                      ;Save used register

                IN      AL,60H                  ;Get key scan code
                CMP     AL,HOTKEY               ;Check if hot-key
                JNE     PROCESS_KEY             ;If not, continue on.

                MOV     AH,2                    ;Get shift status fn
                INT     16H                     ;Thru BIOS

                AND     AL,0FH                  ;Test only for 'shift' keys
                CMP     AL,SHIFT_MASK           ;If they match our combination
                JE      OUR_KEY                 ;then is our signal
PROCESS_KEY:
                POP     AX                      ;Restore register
                JMP     DWORD PTR CS:OLD_INT_9  ;Process key as normal
OUR_KEY:
;------------------------------------------------------------------------
;  Reset the keyboard interrupt controller (forget the key stroke)
;------------------------------------------------------------------------
                IN      AL,61H                  ;These instructions reset
                MOV     AH,AL                   ; the keyboard.
                OR      AL,80H
                OUT     61H,AL
                MOV     AL,AH
                JMP     SHORT $+2               ;I/O delay
                OUT     61H,AL
                CLI                             ;Disable interrupts and
                MOV     AL,20H                  ;reset the int controller
                OUT     20H,AL
                STI                             ;Allow interrupts

;------------------------------------------------------------------------
;       If program is already active, or DOS is busy, simply return.
;------------------------------------------------------------------------
                CMP     CS:ACTIVE,0             ;If already active, can't call
                JNE     RETURN_A

                MOV     AX,CS:KEY_PTR           ;If head of our key buffer
                CMP     AX,CS:KEY_TAKE          ; isn't = tail
                JNE     RETURN_A                ; we still have keys to lose

                INC     CS:ACTIVE               ;Turns off BIOS flag in INT_16
                MOV     AH,1                    ;If the BIOS key buffer
                INT     16H                     ; has keys in it
                MOV     CS:ACTIVE,0
                JNZ     RETURN_A                ; don't pop up

                PUSH    DS                      ;Save used registers
                PUSH    BX

                LDS     BX,CS:DOS_FLAG          ;If DOS critical flag is not
                CMP     BYTE PTR [BX],0         ; busy
                JE      INVOKE                  ;We can pop up

                CMP     CS:LO_FN_FLAG,0         ;If busy from low function
                JNE     INVOKE                  ; go pop up
RETURN_B:
                POP     BX                      ;Restore other registers
                POP     DS
RETURN_A:
                POP     AX                      ;Restore register
                IRET                            ;Go back where we came from
INVOKE:
;------------------------------------------------------------------------
;  From the video mode, determine the box colors to use.
;------------------------------------------------------------------------
                MOV     WORD PTR CS:NCLR,CO_ATTR ;Use color window
                MOV     AH,0FH                  ;Get current video mode fn
                CALL    VIDEO                   ;Thru BIOS
                MOV     CS:DISPLAY_PAGE,BH      ;Save current page
                                                ;Valid video modes are:
                CMP     AL,1                    ;COLOR 40x25
                JE      MODE_OK
                CMP     AL,3                    ;COLOR 80x25
                JE      MODE_OK
                MOV     WORD PTR CS:NCLR,BW_ATTR ;Default to mono window
                CMP     AL,7                    ;MONO 80x25
                JE      MODE_OK
                CMP     AL,2
                JA      RETURN_B                ;Go back from whence we came
MODE_OK:
;------------------------------------------------------------------------
;  If here, routine becomes active, save all other used registers.
;------------------------------------------------------------------------
                MOV     CS:ACTIVE,1             ;Set flag to prevent re-entry

                PUSH    CX                      ;Save all registers for return
                PUSH    DX
                PUSH    DI
                PUSH    SI
                PUSH    ES
                PUSH    BP

                MOV     AX,CS                   ;Put our CS into these regs
                MOV     DS,AX                   ;So we can find our data
                MOV     ES,AX                   ;And our string moves
        ASSUME  DS:CSEG,ES:CSEG                 ;Tell the Assembler
                MOV     OLD_SS,SS               ;Swap stacks after all
                MOV     OLD_SP,SP               ; registers are pushed
                CLI                             ;Turn off interrupts
                MOV     SS,AX                   ;Put our stack in place
                MOV     SP,OFFSET STACK
                STI                             ;Interrupts on
        ASSUME  SS:CSEG                         ;Tell the Assembler

;------------------------------------------------------------------------
;  Save the details of the current screen for later restoration.
;------------------------------------------------------------------------
                MOV     AH,3                    ;Get cursor position fn
                CALL    VIDEO                   ;Thru BIOS
                MOV     CURSOR_POS,DX           ;Save position for
                                                ;restoration on exit
;------------------------------------------------------------------------
;  Save section of screen we will be writing over.
;------------------------------------------------------------------------
                MOV     DI,OFFSET SCREEN_BUF    ;Destination for save
                MOV     SI,0FFFFH               ;Switch for proc to save
                CALL    SCREEN

;------------------------------------------------------------------------
;  Perform specific function.
;------------------------------------------------------------------------
                CALL    CLR_BOX                 ;Draw box & border
                CALL    MENU_TIME
CANCEL:
;------------------------------------------------------------------------
;  Restore the screen to original state.
;------------------------------------------------------------------------
                MOV     SI,OFFSET SCREEN_BUF
                CALL    SCREEN

                MOV     AH,2                    ;Set Cursor position fn
                MOV     DX,CURSOR_POS           ;Restore old cursor position
                CALL    VIDEO                   ;Thru BIOS

                MOV     AX,OLD_SS               ;Restore previous stack
                MOV     BX,OLD_SP
                CLI                             ;No interrupts
                MOV     SS,AX
                MOV     SP,BX
                STI                             ;Allow interrupts

                MOV     ACTIVE,0                ;Turn off active flag

                POP     BP                      ;Restore all used registers
                POP     ES
                POP     SI
                POP     DI
                POP     DX
                POP     CX
                POP     BX
                POP     DS
                POP     AX

                IRET                            ;Interrupt gets IRET
INT_9   ENDP

;========================================================================
;  BIOS Video Interrupt.  Some older versions of the BIOS destroy the
;  BP register inside the video routine.
;------------------------------------------------------------------------
VIDEO           PROC    NEAR

                PUSH    BP                      ;Preserve register
                INT     10H                     ;Call to BIOS
                POP     BP                      ;Restore
                RET

VIDEO           ENDP

;========================================================================
;  Perform the screen save/restore.
;  SAVE:    SI=FFFF, DI=buffer address
;  RESTORE: SI=buffer address, DI=don't care
;------------------------------------------------------------------------
SCREEN          PROC    NEAR
                ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:NOTHING

                CLD                             ;String moves forward
                MOV     BH,DISPLAY_PAGE         ;Just to be sure, reset page

                MOV     CX,NROW                 ;Row loop
                MOV     ROW,BOX_ROW             ;Init row pointer
ROW_LOOP:
                PUSH    CX                      ;Prepare for...
                MOV     CX,NCOL                 ;...column loop
                MOV     COL,BOX_COL             ;Column Pointer
COL_LOOP:
                CMP     SI,0FFFFH               ;SI =FFFF if SAVE
                JE      DO_SAVE
                                                ;RESTORE
                LODSW                           ;AX <- [SI]
                                                ;AH=ATTR AL=CHAR
                CALL    CRT_CHAR                ;Write char to screen
                JMP     SHORT DO_LOOP
DO_SAVE:
                CALL    SET_CUR                 ;Position cursor
                MOV     AH,8                    ;Get char & attribute fn
                CALL    VIDEO                   ;Thru BIOS
                STOSW                           ;[di+=2]=ax
DO_LOOP:
                INC     COL                     ;Next column
                LOOP    COL_LOOP                ;Close Inner loop

                POP     CX                      ;Return to outer loop
                INC     ROW                     ;Next row
                LOOP    ROW_LOOP                ;Close Outer loop
                RET

SCREEN          ENDP

;========================================================================
;  Clear a window (box) for our information on the screen.
;  Add a border for a nice touch.
;------------------------------------------------------------------------
BOX_MSG         DB      BOX_COL+2,BOX_ROW,0B5H,"SlashBar 1.0",0C6H,0
BOX_CHARS       DB      0C9H,0CDH,0BBH,0BAH,020H,0BAH,0C8H,0CDH,0BCH

CLR_BOX         PROC    NEAR

                MOV     AX,0600H                ;Scroll entire window fn
                MOV     CH,BOX_ROW              ;Upper row
                MOV     ROW,CH
                MOV     CL,BOX_COL              ;Left column
                MOV     DH,BOX_ROW + NROW - 1   ;Lower row
                MOV     DL,BOX_COL + NCOL - 1   ;Right column
                MOV     BH,NCLR                 ;Window color
                CALL    VIDEO                   ;Thru BIOS

                MOV     BH,DISPLAY_PAGE         ;This page
                MOV     AH,NCLR                 ;This color
                MOV     SI,OFFSET BOX_CHARS     ;Source of characters
```

```
                MOV     DX,CX                   ;Cursor from last call
                MOV     CX,NROW                 ;Number of rows to draw
CB_1:
                PUSH    CX                      ;Save counter
                MOV     COL,BOX_COL             ;Set column

                LODSB                           ;Get leftmost char
                CALL    CRT_CHAR                ; write to screen

                LODSB                           ;Get middle char
                MOV     CX,NCOL-2               ;Number copies to write
CB_1A:
                INC     COL                     ;Next column
                CALL    CRT_CHAR                ;Write char to screen
                LOOP    CB_1A
                INC     COL                     ;Last column

                LODSB                           ;Get rightmost char
                CALL    CRT_CHAR                ; put on screen

                INC     ROW                     ;Next row
                POP     CX                      ;Restore counter
                CMP     CL,NROW                 ;If written last row
                JE      CB_2                    ; put new chars
                CMP     CL,2                    ;If 2nd row
                JE      CB_2                    ; get new chars
                SUB     SI,3                    ;back up & repeat
CB_2:
                LOOP    CB_1                    ;Loop each line

                MOV     SI,OFFSET BOX_MSG       ;Put program name
                LODSW                           ; at this row,col
                MOV     CURSOR_LOC,AX
                MOV     AH,NCLR                 ; and this color
                CALL    CRTZ                    ; on screen
                RET

CLR_BOX         ENDP

;=====================================================================
;  DOS Int 21h intercept.  Set flag while uninterruptable
;  The purpose of this procedure is to keep pop-up from taking control
;  of the machine when doing so would cause a crash.
;---------------------------------------------------------------------
INT_21  PROC    FAR

                CMP     AH,0                    ;If program is using DOS fn 0
                JNE     CHECK
                MOV     AH,4CH                  ;Change it to 4Ch
GO_DIRECT:
                MOV     CS:LO_FN_FLAG,0         ;Not function 1-Ch
                JMP     DWORD PTR CS:OLD_INT_21 ;Jump to original routine
CHECK:
                CMP     AH,0CH                  ;DOS functions call under 0DH
                JA      GO_DIRECT

                MOV     CS:LO_FN_FLAG,1         ; set this flag

                PUSHF                           ;Simulate INT
                CALL    DWORD PTR CS:OLD_INT_21 ; return here

                MOV     CS:LO_FN_FLAG,0         ;Turn off flag
                RET     2                       ;Return to INT source and
                                                ;discard old flags
INT_21  ENDP

;=====================================================================
;  Int 16 intercept.  Use to feed keys to calling programs.
;---------------------------------------------------------------------
LAST_CALL       DB      0               ;Remember last call so first or
                                        ;last key can be removed
INT_16          PROC    FAR
                ASSUME  CS:CSEG, DS:NOTHING, ES:NOTHING, SS:NOTHING

                CMP     CS:ACTIVE,0             ;Don't steal our own 'strokes!
                JNE     GOTO_BIOS               ; get them thru BIOS

                CMP     AH,2                    ;Ignore calls for shift status
                JAE     DONT_SAVE
                MOV     CS:LAST_CALL,AH
DONT_SAVE:
                STI                             ;Interrupts on
                PUSH    BX                      ;Save used register

                MOV     BX,CS:KEY_TAKE          ;Pointer to next keystroke
                CMP     BX,CS:KEY_PTR           ;If no keys in our buffer
                JE      POP_GOTO_BIOS           ;Pass thru to BIOS

                CMP     AH,2                    ;Request for shift status
                JE      POP_GOTO_BIOS           ; goes thru BIOS always

                CMP     AH,0                    ;Wait for key
                JE      UNLOAD_KEY

                CMP     AL,1                    ;Is key stroke ready?
                JNE     POP_GOTO_BIOS           ;return NZ if key ready
                OR      AL,AL                   ;Generate a NZ
                POP     BX
                RET     2                       ;Discard old flags
UNLOAD_KEY:
                MOV     BX,CS:KEY_TAKE          ;Get ptr to key in BX
                MOV     AX,CS:[BX]              ;Get the key in AX
                ADD     CS:KEY_TAKE,2           ;Move the ptr along

                POP     BX                      ;Restore register
                RET     2                       ;Discard flags

POP_GOTO_BIOS:  POP     BX
GOTO_BIOS:      JMP     DWORD PTR CS:OLD_INT_16

INT_16          ENDP

;=====================================================================
; INTERPRETER - Read the contents of menu file and perform functions.
;  BP always contains the address of the start of the MENU buffer.
;       NOTE: THIS PROGRAM MAKES USE OF THE FACT THAT A .COM FILE
;             HAS CS=DS=ES=SS WHEN USING ADDRESSING WITH BP.
;             THEREFORE, SET UP A STACK USING THE CS SEGMENT.
;---------------------------------------------------------------------
;  Data structures.
;---------------------------------------------------------------------
MENU_BASE       DW      FILE_DTA                ;Real address of offset 0
DTA_SIZE        DW      4096                    ;4k bytes by default

OPT_PTR         DW      0                       ;Points to menu choice
LEVEL           DW      0                       ;Depth of menu tree
NOPT            DW      0                       ;Number options this menu

KEY_PTR         DW      KEYS                    ;Points to next empty spot
KEY_TAKE        DW      KEYS                    ;Points to available char

CMD_TABLE       DW      ASK, CR_CMD, EXECUTE, INPUT, BAD_CMD, BAD_CMD
                DW      BAD_CMD, TYPE_KEY, BAD_CMD, BAD_CMD, SEND

CURSOR_LOC      LABEL   WORD
COL             DB      0                       ;Display column
ROW             DB      0                       ;        row

NCLR            DB      07H                     ;Normal video color
RCLR            DB      70H                     ;Reverse video color

;=====================================================================
;  Prime the pointers with their initial values.
;---------------------------------------------------------------------
        ASSUME  CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG
MENU_TIME       PROC    NEAR

                CLD                             ;String moves forward
                XOR     DI,DI                   ;DI = 0
                MOV     AX,OFFSET KEYS          ;Initialize key buffer
                MOV     KEY_PTR,AX
                MOV     KEY_TAKE,AX
                MOV     WORD PTR KEY_STK [DI],AX ;Starting KEY_PTR in stack
                MOV     WORD PTR MENU_STK[DI],10 ;Offset into menu in stack
                MOV     OPT_PTR,DI              ;Point to option 0
                MOV     LEVEL,DI                ;We're at level 0
                MOV     BP,MENU_BASE            ;Always points to menu base

;---------------------------------------------------------------------
;  Put the PROGRAM name on the screen.
;---------------------------------------------------------------------
                MOV     ROW,BOX_ROW             ;This row & column
                MOV     COL,BOX_COL + NCOL - 12

                MOV     AH,NCLR                 ;Normal color attribute
                MOV     AL,0B5H                 ;Char to write
                CALL    CRT_CHAR                ;Write to screen
                MOV     SI,BP                   ;Point to program name

                MOV     CX,10                   ;Maximum chars to write
MT_1:
                INC     COL                     ;Next column
                LODSB                           ;Get char at DS:SI
                OR      AL,AL                   ;If 0
                JZ      MT_2                    ; end of string
                CALL    CRT_CHAR                ; else, write it
                LOOP    MT_1                    ; and continue
MT_2:
                MOV     AL,0C6H                 ;Close box
                CALL    CRT_CHAR                ;Write char

;---------------------------------------------------------------------
;  Menus are built from scratch.
;---------------------------------------------------------------------
BUILD_MENU:
                CALL    CLR_LINES               ;Clear inside of window

                MOV     DI,LEVEL                ;The menu level
                SHL     DI,1                    ; *2 for word access
                MOV     AX, WORD PTR KEY_STK[DI] ;Point to next key save point
                MOV     KEY_PTR,AX              ; and put where it's used

                CALL    GET_MENU_HEAD           ;Offset of menu in DI
                MOV     AX,[BP][DI]             ;Offset 0 has number opts
                MOV     NOPT,AX

                CALL    WRITE_NAMES             ;Write the option names
                CALL    WRITE_HELP              ;Write the help lines
                CALL    GET_KEY                 ;From user
                OR      AL,AL                   ;AL = 0 If extended ascii
                JNZ     ASCII_KEY

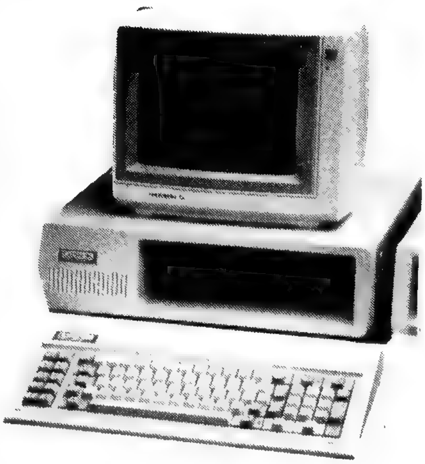
                CALL    MOVE_BAR                ;Could be left/right arrow
                JMP     BUILD_MENU              ; or home/end

;---------------------------------------------------------------------
;  ASCII key could be option letter, CR, ESC, or mistake.
;---------------------------------------------------------------------
ASCII_KEY:
                CALL    MAKE_UC                 ;Make AL upper case
                CALL    MATCH_KEY               ;Return NC if match and
                                                ; AL contains option #
                JNC     MATCH_FOUND             ;No match found
                CALL    [redacted]
                JMP     BUILD_MENU
MATCH_FOUND:
                CMP     AL,0FFH                 ;AL=FF if ESC
                JNE     READ_SCRIPT             ;Else, perform functions

;---------------------------------------------------------------------
;  The ESC key was hit.  Back up one menu.  If at top menu, exit.
;  backing up removes any keystrokes put in by the current menu.
;---------------------------------------------------------------------
                CMP     LEVEL,0                 ;If at top menu
                JE      CANCEL_MENU             ; leave
                DEC     LEVEL                   ;Back up
                MOV     OPT_PTR,0
                JMP     BUILD_MENU              ;Reconstruct display
CANCEL_MENU:
                MOV     KEY_PTR,OFFSET KEYS     ;Flush the buffer
                RET                             ;Return & Exit

;---------------------------------------------------------------------
;  Interpret the option script.
;---------------------------------------------------------------------
READ_SCRIPT:
                CALL    GET_MENU_HEAD           ;Set DI = menu offset
                MOV     AX,OPT_PTR              ;Each option takes 6 bytes
                INC     AX                      ;Extra 6 to point to token ptr
                MOV     BL,6                    ;3 words = 6 bytes
                MUL     BL                      ;Gives Additional offset in AX
                ADD     DI,AX                   ;DI is offset from menu head
                MOV     SI,[BP][DI]             ;SI is offset to token
                ADD     SI,BP                   ;Real address
GET_TOKEN:
                LODSB                           ;Get command token
                MOV     BL,AL                   ;Put in base register
                CMP     BL,MAX_CMD_VAL
                JA      BAD_CMD
                SHL     BL,1                    ;*2 for word access
                XOR     BH,BH                   ;Top is 0
                JMP     CMD_TABLE[BX]           ;Execute based on value
BAD_CMD:
                ;If here, the .BAR file is bad, no recovery
                ;Use the save exit as a top-level-escape
                JMP     CANCEL_MENU

;---------------------------------------------------------------------
;  ASK: Type the following string in the window
;  1st line is used for queries.
;---------------------------------------------------------------------
ASK:
                CALL    CLR_LINES               ;Clear inside of window
                MOV     ROW,BOX_ROW + 1         ;Position the cursor
                MOV     COL,BOX_COL + 2
                MOV     AH,NCLR                 ;Attribute to use
                CALL    CRTZ                    ;Copy chars till 0
```



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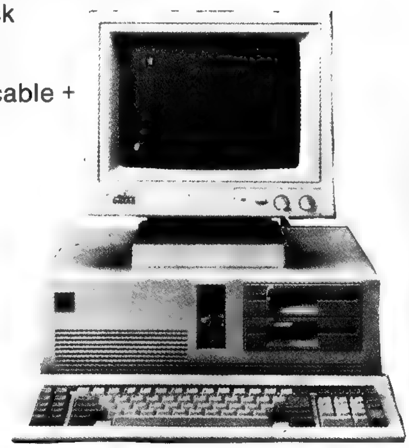

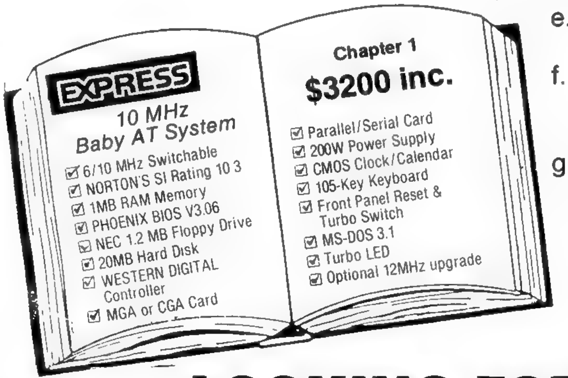

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- Link Loger : HDLC, CSMA/NC
- Maximum No. of stations : 64
- Maximum network length : 4000 feet
- DOS Support : PC/MS-DOS 3.X Concurrent DOS

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TOPNET E+ MODEL
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- Data Rate : 10 Mega bits per second
- Network medium : RG 58/U coax Ethernet coax
- Link Loger : IEEE 802.3 CSMA/CD
- Max No. of Nodes per segment : 100
- Max. segment length : 500M
- Communication Controller : Intel 82586
- On-board micro processor : Intel 80186
- DOS Support : PC/MS-DOS 3.X Concurrent DOS

FUNCTIONS PERFORMED:

☐ DISK SHARING
☐ ELECTRONIC MAIL
☐ FILE/RECORD LOCKING
☐ PRINTER SHARING
☐ CLASSROOM MONITOR
☐ REMOTE DIAL-IN
☐ TELEX SERVER
☐ IBM 3270 SNA GATEWAY

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```
                JMP     GET_TOKEN               ;Get next instruction

;----------------------------------------------------------------------
;  CR:  Put a CR in the buffer.
;----------------------------------------------------------------------
CR_CMD:
                MOV     AX,1C0DH                ;Put a carriage return
                CALL    SAVE_KEY                ; in our key buffer
                JMP     GET_TOKEN               ;Get next instruction

;----------------------------------------------------------------------
;  EXECUTE: transfer control to a lower menu.
;----------------------------------------------------------------------
EXECUTE:
                INC     LEVEL                   ;Next menu level
                MOV     DI,LEVEL                ;Convert to index
                CMP     DI,32                   ;Maximum level of menus
                JB      LEVEL_OK
MENU_ERROR:
                CALL    BEEP                    ;Sound off!
                JMP     CANCEL_MENU             ;And leave no trace
LEVEL_OK:
                SHL     DI,1                    ;Index into tables
                MOV     AX,KEY_PTR              ;Save current key_ptr
                MOV     WORD PTR KEY_STK[DI],AX ; to restore
                                                ;Following token is
                LODSW                           ; offset of new menu
                MOV     WORD PTR MENU_STK[DI],AX ;Saved in "stack"
                MOV     OPT_PTR,0
                JMP     BUILD_MENU              ;Make new picture

;----------------------------------------------------------------------
;  INPUT: Accept keystrokes from the user until CR.
;  2nd line is used for responses.
;----------------------------------------------------------------------
INPUT:
                CALL    BUFFERED_INPUT          ;Buffered input from console
                JNC     GET_TOKEN               ;NC if all went ok
                JMP     BUILD_MENU              ;Else rebuild menu

;----------------------------------------------------------------------
;  TYPE: Put the following keystrokes into the key buffer.
;----------------------------------------------------------------------
TYPE_KEY:
                XOR     AH,AH                   ;High byte is 0
                LODSB                           ;Get char in AL
                OR      AL,AL                   ;0 If end of sequence
                JE      GET_TOKEN               ;Look for next command
                CMP     AL,0FEH                 ;Extended ascii switch
                JNE     TYPE_1                  ;Put char out as is
                LODSB                           ;Get extended code
                CMP     AL,0FEH
                JNE     TYPE_A
                MOV     AX,1C0AH                ;Double FE FE = ctrl-enter
                JMP     SHORT TYPE_2
TYPE_A:
                XCHG    AH,AL                   ;Put code in high byte
                JMP     SHORT TYPE_2            ;Stuff in buffer
TYPE_1:
                MOV     AH,1CH                  ;Add the high bytes to
                CMP     AL,CR                   ; these selected keys
                JE      TYPE_2                  ; for compatibility

                MOV     AH,1
                CMP     AL,ESC_KEY
                JE      TYPE_2

                MOV     AH,0EH
                CMP     AL,BS_KEY
                JE      TYPE_2
                CMP     AL,7FH
                JE      TYPE_2

                INC     AH
                CMP     AL,TAB_KEY
                JE      TYPE_2
                XOR     AH,AH
TYPE_2:
                CALL    SAVE_KEY                ;Put in KEYS buffer
                JMP     TYPE_KEY                ;Try again

;----------------------------------------------------------------------
;  SEND: Signal the end of the pop-up task.
;----------------------------------------------------------------------
SEND:
                MOV     BX,KEY_PTR              ;Pointer to next keystroke
                CMP     BX,KEY_TAKE             ;If no keys in our buffer
                JE      MENU_EXIT               ;No action needed

                CMP     LAST_CALL,0             ;If last call was wait-for-key
                JE      USE_FIRST_KEY           ; stuff first key in buffer

                SUB     KEY_PTR,2               ;Point to last valid key
                SUB     BX,2                    ; move the pointer
                JMP     SHORT REMOVE_KEY        ;Put in BIOS buffer
USE_FIRST_KEY:
                MOV     BX,KEY_TAKE             ;Remove first key
                ADD     KEY_TAKE,2              ; advance pointer
REMOVE_KEY:
                MOV     CX,WORD PTR [BX]        ;Take out the LAST key

                PUSH    DS                      ;Set up for low memory access
                XOR     AX,AX
                MOV     DS,AX
        ASSUME  DS:LO_MEM
                MOV     BX,OFFSET BIOS_HEAD     ;Start of bios key buffer

                CLI
                MOV     WORD PTR [BX][0],001EH  ;Set the head
                MOV     WORD PTR [BX][2],0020H  ;Set the Tail
                MOV     WORD PTR [BX][4],CX     ;Put key in buffer
                STI                             ;Allow interrupts

                POP     DS                      ;Restore the register
        ASSUME  DS:CSEG                         ;Tell the assembler
MENU_EXIT:
                RET

MENU_TIME       ENDP

;======================================================================
;  Put offset of current menu_head into DI.  MENU_STK[LEVEL*2]
;  DI changed.  Other registers preserved.
;----------------------------------------------------------------------

GET_MENU_HEAD   PROC    NEAR

                MOV     DI,LEVEL
                SHL     DI,1
                MOV     DI,WORD PTR MENU_STK[DI]
                RET
```

```
GET_MENU_HEAD   ENDP

;======================================================================
;  Write the current menu option choices to the screen.
;  AX,CX,DX,SI,DI changed.  Others preserved.
;----------------------------------------------------------------------
WRITE_NAMES     PROC    NEAR

                MOV     ROW,BOX_ROW + 1         ;Position is one row down
                MOV     COL,BOX_COL + 1         ;1 col over

                XOR     DX,DX                   ;Option counter
                MOV     CX,NOPT                 ;Number of options this menu
                CALL    GET_MENU_HEAD           ;In DI
WN_1:
                MOV     SI,[BP][DI][2]          ;SI is offset to name
                ADD     SI,BP                   ;SI points to name
WN_2:
                MOV     AH,NCLR                 ;Normal color
                MOV     AL,SPACE                ; with a space
                INC     COL                     ;Separate the names
                CALL    CRT_CHAR
                CMP     OPT_PTR,DX              ;Is this the current option
                JNE     WN_3
                MOV     AH,RCLR                 ;Yes, use reverse color
WN_3:
                CALL    CRTZ                    ;Copy until 0 to CRT
                INC     DX                      ;1 string complete
                ADD     DI,6                    ;Point to next ptr to name
                LOOP    WN_1                    ;Repeat for number of options
                RET

WRITE_NAMES     ENDP

;======================================================================
;  Write the help line for the current option below the names.
;  AX,BX,SI,DI changed.  Others preserved.
;----------------------------------------------------------------------
WRITE_HELP      PROC    NEAR

                MOV     ROW,BOX_ROW + 2
                MOV     COL,BOX_COL + 2

                CALL    GET_MENU_HEAD
                MOV     AX,OPT_PTR              ;3 WORD offset for each opt
                MOV     BL,6
                MUL     BL                      ;Gives Additional offset in AX
                ADD     DI,AX                   ;DI is ptr to offset of help
                MOV     SI,[BP][DI][4]          ;SI is offset ptr to help
                ADD     SI,BP
                MOV     AH,NCLR                 ;Normal color
                CALL    CRTZ                    ;Write string to CON
                RET

WRITE_HELP      ENDP

;======================================================================
;  Read a key from the console with no echo.
;  Return in AX.  Other registers preserved.
;----------------------------------------------------------------------
GET_KEY         PROC    NEAR

                XOR     AH,AH                   ;AH=0, wait for key
                INT     16H                     ; Thru BIOS
                RET

GET_KEY         ENDP

;======================================================================
;  Keystroke was extended ascii.  If left/right arrow, move opt_ptr.
;  BX,CX changed.  Other registers preserved.
;----------------------------------------------------------------------
MOVE_BAR        PROC    NEAR

                MOV     BX,OPT_PTR              ;Current position
                MOV     CX,NOPT                 ;Maximum position is # opt
                DEC     CX                      ; minus one

                CMP     AH,RIGHT_ARROW          ;Move right
                JNE     MB_1
                INC     BX                      ;Increase pointer
                CMP     BX,CX                   ;Past max?
                JBE     MB_EXIT                 ;No, exit
MB_0:
                XOR     BX,BX                   ;Yes, reset to 0
                JMP     SHORT MB_EXIT           ;and leave
MB_1:
                CMP     AH,LEFT_ARROW           ;Move left
                JNE     MB_2
                DEC     BX                      ;Decrease pointer
                JNS     MB_EXIT                 ;Did it go negative?
MB_1A:
                MOV     BX,CX                   ; yes, wrap to max
MB_EXIT:
                MOV     OPT_PTR,BX              ;Change pointer
                RET                             ;Leave
MB_2:
                CMP     AH,HOME_KEY             ;Home - go to 0
                JE      MB_0
MB_3:
                CMP     AH,END_KEY              ;End - move to max
                JE      MB_1A
                CALL    BEEP
                RET

MOVE_BAR        ENDP

;======================================================================
;  Make the character in AL UPPER case.
;----------------------------------------------------------------------
MAKE_UC         PROC    NEAR

                CMP     AL,'a'
                JB      UC_1
                CMP     AL,'z'
                JA      UC_1
                SUB     AL,20H
UC_1:
                RET
MAKE_UC         ENDP

;======================================================================
;  Search current names for matching first letter.  Return CY if no match.
;  If CR, choose current option, and return in AL.  If ESC, set AL=FF.
;  AX,BX,DX changed.  Others preserved.
;----------------------------------------------------------------------
MATCH_KEY       PROC    NEAR

                CMP     AL,ESC_KEY              ;If ESC key hit
                JNE     MK_0
                MOV     AL,0FFH                 ;Signal code
MK_CLC:
                CLC
MK_EXIT:
```

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```
                RET                             ;Return
MK_0:
                MOV     BX,AX                   ;Save key
                MOV     AX,OPT_PTR              ;Current option in AL
                CMP     BL,CR                   ;If CR struck
                JE      MK_CLC                  ;Return option number

                XOR     DX,DX                   ;Option counter
                MOV     CX,NOPT                 ;Number of options this menu
                CALL    GET_MENU_HEAD           ;In DI
MK_1:
                MOV     SI,[BP][DI][2]          ;SI is offset to name
                ADD     SI,BP                   ;SI points to opt name
                LODSB                           ;Get first letter in AL
                CMP     AL,BL                   ;Does key match?
                JE      MK_2

                INC     DX                      ;Next option count
                ADD     DI,6                    ;Point to next ptr to name
                LOOP    MK_1                    ;Repeat for number of options
                STC                             ;Match not found
                RET
MK_2:
                MOV     AX,DX                   ;Put option match in AL
                MOV     OPT_PTR,AX              ;And in pointer
                JMP     MK_CLC

MATCH_KEY       ENDP

;======================================================================
;  Copy an ASCIIZ string to the console at the current cursor location.
;  Cursor position is updated.  SI points to string and is moved.  AH
;  contains the attribute to used for the string.
;  AX,SI changed.  Other registers preserved.
;----------------------------------------------------------------------
CRTZ            PROC    NEAR
CRTZ_1:
                LODSB                           ;Get character
                OR      AL,AL                   ;If char is 0
                JE      CRTZ_2                  ; end of string
                CALL    CRT_CHAR
                INC     COL
                JMP     CRTZ_1
CRTZ_2:
                RET

CRTZ            ENDP

;======================================================================
;  Output the char in AL at the stored cursor position.
;  AH contains the attribute to be used.
;  Preserve all registers.
;----------------------------------------------------------------------
CRT CHAR        PROC    NEAR

                PUSH    AX                      ;Save used registers
                PUSH    BX
                PUSH    CX

                CALL    SET_CUR                 ;Set the cursor
                MOV     CX,1                    ;Write 1 char
                MOV     BL,AH                   ;Use this attribute
                MOV     AH,9                    ;Write char & attr
                MOV     BH,DISPLAY_PAGE         ;This page
                CALL    VIDEO                   ; Thru BIOS

                POP     CX                      ;Restore registers
                POP     BX
                POP     AX
                RET

CRT_CHAR        ENDP

;======================================================================
;  Clear the line in AL.  AX,BX,CX,DX destroyed.
;----------------------------------------------------------------------
CLR_LINES       PROC    NEAR

                MOV     AX,0600H                ;Scroll screen Function
                MOV     CH,BOX_ROW + 1          ;Upper row
                MOV     DH,BOX_ROW + NROW - 2   ;Lower row
                MOV     CL,BOX_COL + 1          ;Left col
                MOV     DL,BOX_COL + NCOL - 2   ;Right col
                MOV     BH,NCLR                 ;Attribute
                CALL    VIDEO                   ;BIOS video
                RET

CLR_LINES       ENDP

;======================================================================
;  Position the cursor at ROW,COL.
;  Preserve all registers.
;----------------------------------------------------------------------
SET_CUR         PROC    NEAR

                PUSH    AX                      ;Save used registers
                PUSH    BX
                PUSH    DX

                MOV     DX,CURSOR_LOC           ;Load both row & col
                MOV     AH,2                    ;Move cursor fn
                MOV     BH,DISPLAY_PAGE         ;Current page
                CALL    VIDEO                   ; Thru BIOS

                POP     DX                      ;Restore registers
                POP     BX
                POP     AX
                RET

SET_CUR         ENDP

;======================================================================
;  Save the key in AX in KEYS buffer
;----------------------------------------------------------------------
SAVE_KEY        PROC    NEAR

                PUSH    BX                      ;Save used registers
                PUSH    CX

                MOV     CX,KEY_PTR              ;Current pointer
                MOV     BX,CX                   ; also in BX
                SUB     CX,OFFSET KEYS          ;Get # bytes
                CMP     CX,512                  ;More than allowed?
                JE      SK_1                    ;Simply ignore
                MOV     [BX],AX                 ;Store key
                ADD     KEY_PTR,2               ;Move pointer
SK_1:
                POP     CX                      ;Restore registers
                POP     BX
                RET

SAVE_KEY        ENDP
```

```
;======================================================================
;  Read keys from the keyboard until a <CR>
;----------------------------------------------------------------------
BUFFERED_INPUT  PROC    NEAR

                PUSH    AX                      ;Save registers
                PUSH    CX
                PUSH    SI
BUF_ERASE:
                MOV     ROW,BOX_ROW + 2         ;Position cursor
                MOV     COL,BOX_COL + 1
                CALL    SET_CUR
                MOV     AX,0A20H                ;Fill with blanks
                MOV     BH,DISPLAY_PAGE
                MOV     CX,NCOL - 2
                CALL    VIDEO                   ; Thru BIOS

                MOV     SI,OFFSET INKEY_BUF     ;Point to start of buffer
BUF_1:
                MOV     CX,SI                   ;Calculate buffer length
                SUB     CX,OFFSET INKEY_BUF     ; in CX
                CALL    SET_CUR                 ;Position cursor
                CALL    GET_KEY                 ;Read a key from the kbd

                OR      AL,AL                   ;If low byte is 0
                JZ      BUF_1                   ; not ascii

                CMP     AL,CR                   ;Enter key
                JE      BUF_CR

                CMP     AL,ESC_KEY              ;Escape
                JE      BUF_ESC

                CMP     AL,BS_KEY               ;Backspace
                JE      BUF_BS

                CMP     CX,76 * 2               ;Maximum bytes allowed
                JA      BUF_2A
BUF_1A:
                MOV     [SI],AX                 ;Save key in INKEY_BUF
                ADD     SI,2                    ;Point to next entry
BUF_2:
                MOV     AH,NCLR
                CALL    CRT_CHAR                ;Write AL at row,col
                INC     COL                     ;Next column
                JMP     BUF_1                   ;Get more keys
BUF_BS:
                OR      CX,CX                   ;Any keys in buf?
                JNZ     BUF_3
BUF_2A:
                CALL    BEEP
                JMP     BUF_1
BUF_3:
                SUB     SI,2                    ;Remove key
                DEC     COL                     ;Write over char
                MOV     AL,SPACE                ; with space
                MOV     AH,NCLR                 ;Normal color
                CALL    CRT_CHAR                ;Do it
                JMP     BUF_1
BUF_ESC:
                OR      CX,CX                   ;If chars in buf
                JNZ     BUF_ERASE               ;Erase them all
                STC                             ;Carry means we're backing out
                JMP     SHORT BUF_RET
BUF_CR:
                OR      CX,CX                   ;If no chars
                JZ      BUF_OK                  ; simply return
                SHR     CX,1                    ;Number of words to transfer
                MOV     SI,OFFSET INKEY_BUF
                CLD
BUF_LOOP:
                LODSW
                CALL    SAVE_KEY
                LOOP    BUF_LOOP
BUF_OK:
                CLC
BUF_RET:
                POP     SI                      ;Restore regs
                POP     CX
                POP     AX
                RET

BUFFERED_INPUT  ENDP

;======================================================================
;  Beep at the terminal.
;----------------------------------------------------------------------
BEEP            PROC    NEAR

                PUSH    AX                      ;Save register
                MOV     AX,0E07H                ;write a 'beel'
                CALL    VIDEO                   ; Thru BIOS
                POP     AX                      ;Restore
                RET

BEEP            ENDP

;======================================================================
;  Hook the necessary interrupts to avoid a collision.  Read command line
;  Parameters.  Terminate and Stay Resident (TSR).
;----------------------------------------------------------------------
GREEDY_MSG      DB      "/n Too Big$"
BIG_FILE        DB      "File Too Big$"
BAD_FILE_MSG    DB      "Error Opening File$"
USAGE_MSG       DB      "Usage: SLASHBAR [path]menuname.ext [/n]$"

INITIALIZE      PROC    NEAR
                ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:CSEG

                MOV     DX,OFFSET COPYRIGHT     ;Say who we are
                MOV     AH,9                    ;Display string function
                INT     21H                     ;Thru DOS
                CALL    CHECK_VERSION           ;Version 2.0+ or don't return

;----------------------------------------------------------------------
;  Check if already loaded in memory.  Don't load multiple copies.
;  When this routine ends, ES points to usable copy in memory.  It may
;  not be the same as CS.
;----------------------------------------------------------------------
                MOV     WORD PTR [ENTPT+0],0    ;Modify to avoid false match
                MOV     WORD PTR [ENTPT+2],0

                XOR     BX,BX                   ;BX = segment to compare
                MOV     AX,CS                   ;AX = our segment
NEXT_PARA:
                INC     BX                      ;Next paragraph
                MOV     ES,BX                   ;Set search segment
                CMP     AX,BX                   ;If current paragraph...
                JE      END_SEARCH              ;...stop
                MOV     SI,OFFSET ENTPT         ;String to compare
                MOV     DI,SI                   ;Offset is same
                MOV     CX,16                   ;Compare first 16 words
                REP     CMPSW                   ;CMP DS:SI TO ES:DI
```

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                OR      CX,CX                   ;All matched?
                JNZ     NEXT_PARA               ;No, continue search
                JMP     SHORT SIZE_OK           ;Found a copy at ES

;-----------------------------------------------------------------------
;  Didn't find a copy in memory.  Look for memory size switch.
;-----------------------------------------------------------------------
END_SEARCH:
                MOV     DI,80H                  ;# chars on command line
                MOV     CL,[DI]                 ; in CL
                XOR     CH,CH                   ;CH = 0
                INC     DI                      ;Point to 1st char
                MOV     AL,'/'                  ;Look for slash
                REPNE   SCASB                   ;Do it for CX chars
                JCXZ    SIZE_OK                 ;No switch on line

                MOV     SI,DI                   ;Point SI to n parameter
                DEC     DI                      ;Make sure any file name
                MOV     BYTE PTR [DI],CR        ; has return after it
                MOV     DI,10                   ;Base 10 (decimal)
                MOV     CX,5                    ;Maximum 5 digits
                XOR     BX,BX                   ;Size in BX
GET_MEM_SIZE:
                LODSB                           ;Get digit
                SUB     AL,30H                  ;ASCII to digit
                CMP     AL,9                    ;Must be 0-9
                JA      SAVE_SIZE               ; else, end of num
                XCHG    AX,BX                   ;Put digit in BX
                MUL     DI                      ;Multiply sum x 10
                XOR     BH,BH                   ;Make BX single digit
                ADD     BX,AX                   ;Sum in BX
                LOOP    GET_MEM_SIZE            ;Continue


SAVE_SIZE:
                MOV     DTA_SIZE,BX             ;Place in variable
                XOR     AX,AX                   ;Check 64 K limit
                DEC     AX
                SUB     AX,BX
                CMP     AX,OFFSET LAST_BYTE
                JA      SIZE_OK
                MOV     DX,OFFSET GREEDY_MSG

ERROR_EXIT:
                MOV     AH,9                    ;Display string fn
                INT     21H                     ; Thru DOS
                MOV     AX,4C01H                ;Terminate with error=1
                INT     21H                     ; Thru DOS

SIZE_OK:
;-----------------------------------------------------------------------
;  Read the command line for a path/file spec.
;  ES may point to the resident copy!
;-----------------------------------------------------------------------
                MOV     SI,81H                  ;Command line in PSP
FIND_START:
                LODSB                           ;Get char
                CMP     AL,SPACE                ;If a space
                JE      FIND_START              ; skip to next char
                CMP     AL,CR                   ;If NOT CR
                JNE     HAVE_START              ; found start of spec
                MOV     DX,OFFSET USAGE_MSG     ;CR = error, no file name
                JMP     ERROR_EXIT
HAVE_START:
                MOV     DX,SI
                DEC     DX                      ;Name starts here


FIND_END:
                LODSB                           ;Get char
                CMP     AL,SPACE                ;A space
                JE      NAME_OK
                CMP     AL,CR                   ;or CR ends name
                JNE     FIND_END
NAME_OK:
                DEC     SI                      ;Back up 1 char
                MOV     BYTE PTR [SI],0         ; make ASCIIZ
                MOV     AX,3D00H                ;Open for reading
                INT     21H                     ; Thru DOS
                JNC     OPEN_OK
FILE_ERR:
                MOV     DX,OFFSET BAD_FILE_MSG
                JMP     ERROR_EXIT


OPEN_OK:
                MOV     BX,AX                   ;Save handle in BX
                MOV     AX,4202H                ;Move file pointer
                XOR     CX,CX                   ; 0 bytes from end
                XOR     DX,DX
                INT     21H                     ; Thru DOS
                JC      FILE_ERR

                CMP     AX,DTA_SIZE             ;AX has # bytes in file
                JBE     FILE_FINE               ;Size OK
                MOV     DX,OFFSET BIG_FILE
                JMP     ERROR_EXIT


FILE_FINE:
                PUSH    AX                      ;Number of bytes to read
                MOV     AX,4200H                ;Move file pointer
                XOR     CX,CX                   ; 0 bytes from start
                XOR     DX,DX
                INT     21H                     ; Thru DOS
                POP     CX
                JC      FILE_ERR

                MOV     AH,3FH                  ;Read file fn
                MOV     DX,OFFSET FILE_DTA      ;Put data at this offset
                PUSH    DS                      ;(Save DS)
                PUSH    ES                      ;Put ES (resident segment)
                POP     DS                      ; into DS (DS:DX is DTA)
                INT     21H                     ;Thru DOS
                POP     DS                      ;Restore old DS
                JC      FILE_ERR

                MOV     AH,3EH                  ;Close file Fn
                INT     21H                     ; Thru DOS

                MOV     CX,CS                   ;Check if ES=CS, i.e.,
                MOV     BX,ES                   ;there is no resident copy
                CMP     CX,BX
                JE      KEEP

                MOV     AX,4C00H
                INT     21H

KEEP:
;-----------------------------------------------------------------------
;  Get a pointer to the DOS Critical Flag, a one-byte location in low memory
;  that is set when DOS is in an uninterruptable state.  Location is returned
;  in ES:BX.  This is undocumented, but works in DOS 2.0 - 3.21
;-----------------------------------------------------------------------
                PUSH    ES
                MOV     AH,34H                  ;Get Interrupt Flag address
                INT     21H

                MOV     WORD PTR DOS_FLAG[0],BX ;offset
                MOV     WORD PTR DOS_FLAG[2],ES ;segment
                POP     ES


;-----------------------------------------------------------------------
;  Hook the keyboard interrupt 9h for the hot-key detection routine.
;  Hook Int 16h for BIOS keyboard control.
;  Hook DOS Interrupt 21h,25h,26h and BIOS 13h to set busy flags.
;-----------------------------------------------------------------------
                MOV     AL,9                    ;Interrupt number
                MOV     DI,OFFSET OLD_INT_9     ;Store vector here
                MOV     DX,OFFSET INT_9         ;New interrupt procedure
                CALL    SET_INT                 ;Make change

                MOV     AL,16H
                MOV     DI,OFFSET OLD_INT_16
                MOV     DX,OFFSET INT_16
                CALL    SET_INT

                MOV     AL,21H
                MOV     DI,OFFSET OLD_INT_21
                MOV     DX,OFFSET INT_21
                CALL    SET_INT

;-----------------------------------------------------------------------
;  Deallocate the copy of the environment loaded with the program.
;  Establish memory residency and terminate.
;-----------------------------------------------------------------------
                MOV     AX,WORD PTR DS:[2CH]    ;Address of environment
                MOV     ES,AX                   ;In ES register
                MOV     AH,49H                  ;Release allocated memory
                INT     21H                     ;Thru DOS

                MOV     DX,OFFSET LAST_BYTE - OFFSET CSEG + 15
                ADD     DX,DTA_SIZE             ;Total size in bytes
                MOV     CL,4                    ; /16 =
                SHR     DX,CL                   ;In paras
                MOV     AX,3100H                ;Keep (TSR)
                INT     21H                     ;Thru DOS

INITIALIZE      ENDP

;=======================================================================
;  Check for the correct version of DOS.  Return if 2.0 or later.
;  Terminate if 1.x.  AX destroyed on return.
;-----------------------------------------------------------------------


BAD_DOS_MSG     DB      "SlashBar: Requires DOS 2.0+",CR,LF,"$"

CHECK_VERSION   PROC    NEAR
                ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:CSEG

                MOV     AH,30H                  ;Get DOS version number fn
                INT     21H                     ;Thru DOS
                                                ;AL=major ver #,AH=minor ver #
                CMP     AL,02                   ;Compare to 2.0
                JAE     VER_OK                  ;If 2.0 or later, go on.

                MOV     DX,OFFSET BAD_DOS_MSG   ;DS:DX is message
                MOV     AH,9                    ;Display string fn
                INT     21H                     ;Thru DOS
                INT     20H                     ;Exit 1.0 style
VER_OK:
                RET

CHECK_VERSION   ENDP

;=======================================================================
;  Get/Save/Set the interrupt vector.  AL contains vector number.
;  ES:DI points to DWORD destination for old address.
;  DS:DX points to new interrupt address.  AX destroyed.
;-----------------------------------------------------------------------

SET_INT         PROC    NEAR
                ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:CSEG

                PUSH    ES
                PUSH    AX                      ;Save vector # in AL
                MOV     AH,35H                  ;Get address function
                INT     21H                     ;Thru DOS
                MOV     WORD PTR [DI+0],BX      ;Save address in ES:DI
                MOV     WORD PTR [DI+2],ES
                POP     AX                      ;Get AL back
                MOV     AH,25H                  ;Set new address to DS:DX
                INT     21H                     ;Thru DOS
                POP     ES
                RET

SET_INT         ENDP

;=======================================================================
;  Data here is allocated after the program loads into memory to save space
;  in the COM file so the basic listing will be smaller.
;  PC variable used to keep track of relative addresses.
;-----------------------------------------------------------------------
PC              =       $                       ;Set imaginary counter

SCREEN_BUF      =       PC                      ;DB NROW*NCOL*2 DUP(?)
PC              =       PC + NROW * NCOL

KEYS            =       PC                      ;DW 256 DUP(0)
PC              =       PC + 256 * 2
                                                ;For buffered input
INKEY_BUF       =       PC                      ;DW 76 DUP(0)
PC              =       PC + 76 * 2

KEY_STK         =       PC                      ;DW 32 DUP(0)
PC              =       PC + 32 * 2

MENU_STK        =       PC                      ;DW 32 DUP(0)
PC              =       PC + 32 * 2

FILE_DTA        =       PC
LAST_BYTE       =       PC

CSEG    ENDS
        END     ENTPT
```

Shift key (● = pressed)

SHIFT-MASK Value	Alt	Ctrl	Left Shift	Right Shift
0				
1				●
2			●	
3			●	●
4		●		
5		●		●
6		●	●	
7		●	●	●
8	●			
9	●			●
A	●		●	
B	●		●	●
C	●	●		
D	●	●		●
E	●	●	●	
F	●	●	●	●

SHIFT-MASK value table

keys, but for our purposes, they generate the same scan code.) The SHIFT_MASK value is determined by which shift keys must be pressed at the same time as the hot key, to activate SLASHBAR. Use the 'SHIFT-MASK value table' to determine the value to use for SHIFT_MASK. You'll note both from this table and from the .ASM listing in Fig 1 that the program default — the Alt key — has the value of 08.

Once you've got the values you want to use for the HOTKEY scan code and SHIFT_MASK, you're ready to patch SLASHBAR.COM directly using DEBUG. Working with a copy of SLASHBAR.COM, in case you make a mistake, follow the example below, substituting your selected scan code where you see SS to replace the 35 default at offset 167, and the shift mask code where you see MM. All numbers are in hex, and you don't have to type the semicolons or anything to the right of them.

```
DEBUG SLASHBAR.COM
E 167 SS        ;Scan code here
E 171 MM        ;Shift mask here
W
Q
```

Inside SLASHBAR

While you can successfully use SLASHAR without looking at the material below, many readers will probably be interested in how the program works. Whenever the SLASHBAR.COM file is executed, control is transferred to the INITIALIZE procedure. Here, after the copyright notice is displayed, a procedure is called to check the DOS version. This is necessary because SLASHBAR uses some DOS functions that are available only in DOS 2.0 and later. Interrupt 21h function 30h reports the same version as you see when you execute the DOS VER command.

The INITIALIZE procedure performs two major functions. The first is to determine if a resident copy of SLASHBAR already exists, and if not, to load one. SLASHBAR determines this by searching for its copyright notice in memory. If a previously loaded copy is found, the ES register is set to the segment of the resident copy. The second function is to copy the contents of the specified file into the file buffer of the resident copy pointed to by the ES register.

When DOS executes a program, any characters on the command line are copied to an area at offset 80h in the Program Segment Prefix (PSP). This area is scanned for the /n buffer size parameter. The /n switch must follow the filename and is ignored if SLASHBAR is already resident. (The only way to change the buffer size is to reboot the computer to remove SLASHBAR from memory and execute it again with a larger /n.) If the /n switch is found, up to five following digits are read and converted to a number. Because of the addressing scheme used, the entire memory image, including the file buffer, must fit in a 64k segment. If a buffer size that would exceed this limit is requested, an error message is produced. (The largest file the MAKEBAR compiler can produce is 46,000 bytes, so this should present no problem.)

The second major function of SLASHBAR is as a file loader. While the /n parameter is optional, the name of a compiled menu file must always be specified. (Note that SLASHBAR does not check to see if the file contents are valid. Any file may be loaded, but the probable result is a cold reboot.) The filename may also include a path, if desired. The file parameter must be the first argument on the command line and is opened using the DOS file handle fuctions.

Pointer power

If the menu file is opened successfully, its size must be found to ensure that it will fit the resident buffer. When DOS opens a file with a handle, it keeps track of its position in the file with a handle pointer. Reading or writing to the file causes the value of the pointer to reflect the new position. The pointer may also be moved manually. DOS interrupt 21h provides the 'Move file pointer' (LSEEK) function, which allows a pointer to be moved by any of three methods. The distance to move (offset) is given as an unsigned 32-bit integer in the CX:DX register pair. The AL register is used to hold the method code, and if set to 0, the pointer will be positioned CX:DX bytes from the start of the file. If AL=1, the pointer is moved CX:DX bytes forward from its present position. And if AL=2, the pointer will be positioned CX:DX bytes back from the end of the file. Whichever method is used, the new pointer position is returned in the DX:AX register pair.

By setting the registers to position the pointer 0 bytes from the end of the .BAR file, the DX:AX register pair will return the number of bytes in the file. This method is used to determine file size. If the allocated buffer is large enough to hold the entire file, the file pointer is then moved back to the beginning (rewound) and the 'Read file'

Key	Scan code in hex
Esc	01
!1	02
@2	03
#3	04
$4	05
%5	06
^6	07
&7	08
*8	09
(9	0A
)0	0B
_-	0C
+ =	0D
Backspace	0E
Tab	0F
Q	10
W	11
E	12
R	13
T	14
Y	15
U	16
I	17
O	18
P	19
{[	1A
}]	1B
Enter	1C
Ctrl	1D
A	1E
S	1F
D	20
F	21
G	22
H	23
J	24
K	25
L	26
:;	27
“’	28
~‘	29
Left Shift	2A
|\	2B
Z	2C
X	2D
C	2E
V	2F
B	30
N	31
M	32
<,	33
.	34
?/	35
Right Shift	36
PrtSc *	37
Alt	38
Spacebar	39
Caps Lock	3A
F1	3B
F2	3C
F3	3D
F4	3E
F5	3F
F6	40
F7	41
F8	42
F9	43
F10	44
NumLock	45
ScrollLock	46
7 Home	47
8 Up Arrow	48
9 PgUp	49
-	4A
4 Left Arrow	4B
5	4C
6 Right Arrow	4D
+	4E
1 End	4F
2 Down Arrow	50
3 PgDn	51
0 Ins	52
.Del	53

Keyboard scan codes for alternative hot keys

function is used to transfer the file contents into memory. If a copy of SLASHBAR is already resident, the file contents are loaded into the resident copy, replacing the previous BAR menu.

Thanks for the memory

If SLASHBAR is not executing for the first time, it functions simply as a file loader. When that task is complete, it terminates and returns control to DOS. On the fist execution, however, several steps must be taken to make SLASHBAR memory resident and hook it into the operating system.

SLASHBAR uses DOS INT 21h function 31h (Keep), which is an advanced version of interrupt 27h, terminate-and-stay-resident (TSR) call. Keep takes as an argument the amount of memory, in paragraphs, that should be set aside. In addition to reserving memory for the program portion of SLASHBAR, the procedure sets memory aside for buffers needed for normal operation. These buffers are listed at the end of the assembly listing.

If the resident copy of SLASHBAR is to gain control of the computer, it must be able to detect when its hot-key combination has been typed. Each time a key is pressed on the PC, the keyboard generates an INT 9 to pass control to the BIOS. SLASHBAR splices into INT 9 by saving the current interrupt handler address and substituting the address of its own keyboard routine. This is done with the DOS INT 21h functions 25h, ‘Set interrupt vector’, and 35h, ‘Get interrupt vector’.

SLASHBAR now monitors the scan codes reported by interrupt 9 as the keys are typed. If the scan code for the / (slash) key is reported, the status of the shift keys is checked. If the Alt key is also pressed, SLASHBAR interprets this as a request to pop up. Other combinations are passed to the regular keyboard handler.

The ability to pop up while other programs are running has some drawbacks. Because current versions of DOS are not designed to support multiple programs, misbehaved programs can do irreparable harm to DOS's internal structure and cause the PC to hang. To prevent SLASHBAR from appearing when it shouldn't, some anti-pop-up features have been included in its design. Perhaps the most obvious is to prevent SLASHBAR from popping up inside itself. A 1-byte location in memory (called ACTIVE in the ASM listing) keeps track of the state of SLASHBAR. Normally, this location contains a value of zero. When SLASHBAR detects an Alt-Slash key combination and prepares to pop up, it checks this location first. If ACTIVE still contains the zero, the process is allowed to continue and a 1 is stored in ACTIVE to indicate a busy condition. If ACTIVE is nonzero, SLASHBAR assumes it is already active, and the keystroke is ignored.

SLASHBAR is, in essence, a keyboard macro program that trans-

```
100 REM -- BASIC PROGRAM TO CREATE SLASHBAR.COM
110 OPEN "SLASHBAR.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  253
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 206377 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA   233,  116,    6,   83,  108,   97,  115,  104,  862
300 DATA    66,   97,  114,   32,   49,   46,   48,   32,  484
310 DATA    40,   99,   41,   32,   49,   57,   56,   55,  429
320 DATA    44,   32,   90,  105,  102,  102,   45,   68,  588
330 DATA    97,  118,  105,  115,   32,   80,  117,   98,  762
340 DATA   108,  105,  115,  104,  105,  110,  103,   32,  782
350 DATA    67,  111,  114,  112,   46,   13,   10,   36,  509
360 DATA    26,   82,  111,   98,  101,  114,  116,   32,  680
370 DATA    76,   46,   32,   72,  117,  109,  109,  101,  662
380 DATA   108,    0,    0,    0,    0,    0,    0,    0,  108
390 DATA     0,    0,    0,    0,    0,    0,    0,    0,    0
400 DATA     0,    0,    0,    0,    0,    0,    0,    0,    0
410 DATA     0,    0,  251,   80,  228,   96,   60,   53,  768
420 DATA   117,   10,  180,    2,  205,   22,   36,   15,  587
430 DATA    60,    8,  116,    6,   88,   46,  255,   46,  625
440 DATA    73,    1,  228,   97,  138,  224,   12,  128,  901
450 DATA   230,   97,  138,  196,  235,    0,  230,   97, 1223
460 DATA   250,  176,   32,  230,   32,  251,   46,  128, 1145
470 DATA    62,   89,    1,    0,  117,   50,   46,  161,  526
480 DATA   155,    3,   46,   59,    6,  157,    3,  117,  546
490 DATA    39,   46,  254,    6,   89,    1,  180,    1,  616
500 DATA   205,   22,   46,  198,    6,   89,    1,    0,  567
510 DATA   117,   22,   30,   83,   46,  197,   30,   85,  610
520 DATA     1,  128,   63,    0,  116,   12,   46,  128,  494
530 DATA    62,   90,    1,    0,  117,    4,   91,   31,  396
540 DATA    88,  207,   46,  199,    6,  183,    3,   23,  755
550 DATA     4,  180,   15,  232,  128,    0,   46,  136,  741
560 DATA    62,   91,    1,   60,    1,  116,   19,   60,  410
570 DATA     3,  116,   15,   46,  199,    6,  183,    3,  571
580 DATA     7,  112,   60,    7,  116,    4,   60,    2,  368
590 DATA   119,  212,   46,  198,    6,   89,    1,    1,  672
600 DATA    81,   82,   87,   86,    6,   85,  140,  200,  767
610 DATA   142,  216,  142,  192,  140,   22,   94,    1,  949
620 DATA   137,   38,   96,    1,  250,  142,  208,  188, 1060
630 DATA     0,    1,  251,  180,    3,  232,   62,    0,  729
640 DATA   137,   22,   92,    1,  191,  232,    8,  190,  873
650 DATA   255,  255,  232,   54,    0,  232,  135,    0, 1163
660 DATA   232,  142,    1,  190,  232,    8,  232,   42, 1079
670 DATA     0,  180,    2,  139,   22,   92,    1,  232,  668
680 DATA    28,    0,  161,   94,    1,  139,   30,   96,  549
690 DATA     1,  250,  142,  208,  139,  227,  251,  198, 1416
700 DATA     6,   89,    1,    0,   93,    7,   94,   95,  385
710 DATA    90,   89,   91,   31,   88,  207,   85,  205,  886
720 DATA    16,   93,  195,  252,  138,   62,   91,    1,  848
730 DATA   185,    4,    0,  198,    6,  182,    3,    0,  578
740 DATA   144,   81,  185,   80,    0,  198,    6,  181,  875
750 DATA     3,    0,  144,  131,  254,  255,  116,    6,  909
760 DATA   173,  232,  185,    3,  235,    9,  232,  223, 1292
770 DATA     3,  180,    8,  232,  208,  255,  171,  254, 1311
780 DATA     6,  181,    3,  226,  230,   89,  254,    6,  995
790 DATA   182,    3,  226,  213,  195,    2,    0,  181, 1002
800 DATA    83,  108,   97,  115,  104,   66,   97,  114,  784
810 DATA    32,   49,   46,   48,  198,    0,  201,  205,  779
820 DATA   187,  186,   32,  186,  200,  205,  180,  184, 1360
830 DATA     0,    6,  181,    0,  136,   46,  182,    3,  554
840 DATA   177,    0,  182,    3,  178,   79,  138,   62,  819
850 DATA   183,    3,  232,  145,  255,  138,   62,   91, 1109
860 DATA     1,  138,   38,  183,    3,  190,  166,    2,  721
870 DATA   139,  209,  185,    4,    0,   81,  198,    6,  822
880 DATA   181,    3,    0,  144,  172,  232,   85,    3,  820
890 DATA   172,  185,   78,    0,  254,    6,  181,    3,  879
900 DATA   232,   74,    3,  226,  247,  254,    6,  181, 1223
910 DATA     3,  172,  232,   64,    3,  254,    6,  182,  916
920 DATA     3,   89,  128,  249,    4,  116,    8,  128,  725
930 DATA   249,    2,  116,    3,  131,  238,    3,  226,  968
940 DATA   204,  190,  149,    2,  173,  163,  181,    3, 1065
950 DATA   138,   38,  183,    3,  232,   15,    3,  195,  807
960 DATA   128,  252,    0,  117,   13,  180,   76,   46,  812
970 DATA   198,    6,   90,    1,    0,   46,  255,   46,  642
980 DATA    81,    1,  128,  252,   12,  119,  240,   46,  879
990 DATA   198,    6,   90,    1,    1,  156,   46,  255,  753
1000 DATA   30,   81,    1,   46,  198,    6,   90,    1,  453
1010 DATA    0,  202,    2,    0,    0,   46,  128,   62,  440
1020 DATA   89,    1,    0,  117,   63,  128,  252,    2,  652
1030 DATA  115,    5,   46,  136,   38,   68,    3,  251,  662
1040 DATA   83,   46,  139,   30,  157,    3,   46,   59,  563
1050 DATA   30,  155,    3,  116,   38,  128,  252,    2,  724
1060 DATA  116,   33,  128,  252,    0,  116,   10,   60,  715
1070 DATA    1,  117,   24,   10,  192,   91,  202,    2,  639
1080 DATA    0,   46,  139,   30,  157,    3,   46,  139,  560
1090 DATA    7,   46,  131,    6,  157,    3,    2,   91,  443
1100 DATA  202,    2,    0,   91,   46,  255,   46,   77,  719
1110 DATA    1,  128,   14,    0,   16,    0,    0,    0,  159
1120 DATA    0,    0,    0,  104,   11,  104,   11,  126,  356
1130 DATA    4,  148,    4,  156,    4,  197,    4,  124,  641
1140 DATA    4,  124,    4,  124,    4,  205,    4,  124,  593
1150 DATA    4,  124,    4,    9,    5,    0,    0,    7,  153
1160 DATA  112,  252,   51,  255,  184,  104,   11,  163, 1132
1170 DATA  155,    3,  163,  157,    3,  137,  133,    0,  751
1180 DATA   14,  199,  133,   64,   14,   10,    0,  137,  571
1190 DATA   62,  149,    3,  137,   62,  151,    3,  139,  706
1200 DATA   46,  145,    3,  198,    6,  182,    3,    0,  583
1210 DATA  198,    6,  181,    3,   68,  138,   38,  183,  815
1220 DATA    3,  176,  181,  232,   71,    2,  139,  245, 1049
1230 DATA  185,   10,    0,  254,    6,  181,    3,  172,  811
1240 DATA   10,  192,  116,    5,  232,   54,    2,  226,  837
1250 DATA  242,  176,  198,  232,   47,    2,  232,   68, 1197
1260 DATA    2,  139,   62,  151,    3,  209,  231,  139,  936
1270 DATA  133,    0,   14,  163,  155,    3,  232,   46,  746
1280 DATA    1,  139,    3,  163,  153,    3,  232,   49,  743
1290 DATA    1,  232,  103,    1,  232,  135,    1,   10,  715
1300 DATA  192,  117,    5,  232,  133,    1,  235,  214, 1129
1310 DATA  232,  180,    1,  232,  188,    1,  115,    5,  954
1320 DATA  232,  224,    2,  235,  201,   60,  255,  117, 1326
1330 DATA   26,  131,   62,  151,    3,    0,  116,   12,  501
1340 DATA  255,   14,  151,    3,  199,    6,  149,    3,  780
1350 DATA    0,    0,  235,  178,  199,    6,  155,    3,  776
1360 DATA  104,   11,  195,  232,  233,    0,  161,  149, 1085
1370 DATA    3,   64,  179,    6,  246,  227,    3,  248,  976
1380 DATA  139,   51,    3,  245,  172,  138,  216,  128, 1092
1390 DATA  251,   10,  119,    8,  208,  227,   50,  255, 1128
1400 DATA  255,  167,  159,    3,  235,  214,  232,  204, 1469
1410 DATA    1,  198,    6,  182,    3,    1,  198,    6,  595
1420 DATA  181,    3,    2,  138,   38,  183,    3,  232,  780
1430 DATA  148,    1,  235,  216,  184,   13,   28,  232, 1057
1440 DATA  218,    1,  235,  208,  255,    6,  151,    3, 1077
1450 DATA  139,   62,  151,    3,  131,  255,   32,  114,  887
1460 DATA    5,  232,  111,    2,  235,  166,  209,  231, 1191
1470 DATA  161,  155,    3,  137,  133,    0,   14,  173,  776
1480 DATA  137,  133,   64,   14,  199,    6,  149,    3,  705
1490 DATA    0,    0,  233,   65,  255,  232,  200,    1,  986
1500 DATA  115,  162,  233,   57,  255,   50,  228,  172, 1272
1510 DATA   10,  192,  116,  152,   60,  254,  117,   14,  915
1520 DATA  172,   60,  254,  117,    5,  184,   10,   28,  830
1530 DATA  235,   34,  134,  224,  235,   30,  180,   28, 1100
1540 DATA   60,   13,  116,   24,  180,    1,   60,   27,  481
1550 DATA  116,   18,  180,   14,   60,    8,  116,   12,  524
1560 DATA   60,  127,  116,    8,  254,  196,   60,    9,  830
1570 DATA  116,    2,   50,  228,  232,  109,    1,  235,  973
1580 DATA  196,  139,   30,  155,    3,   59,   30,  157,  769
1590 DATA    3,  116,   51,  128,   62,   68,    3,    0,  431
1600 DATA  116,   10,  131,   46,  155,    3,    2,  131,  594
1610 DATA  235,    2,  235,    9,  139,   30,  157,    3,  810
1620 DATA  131,    6,  157,    3,    2,  139,   15,   30,  483
1630 DATA   51,  192,  142,  216,  187,   26,    4,  250, 1068
1640 DATA  199,    7,   30,    0,  199,   71,    2,   32,  540
1650 DATA    0,  137,   79,    4,  251,   31,  195,  139,  836
1660 DATA   62,  151,    3,  209,  231,  139,  189,   64, 1048
1670 DATA   14,  195,  198,    6,  182,    3,    1,  198,  797
1680 DATA    6,  181,    3,    1,   51,  210,  139,   14,  605
1690 DATA  153,    3,  232,  226,  255,  139,  115,    2, 1125
1700 DATA    3,  245,  138,   38,  183,    3,  176,   32,  818
1710 DATA  254,    6,  181,    3,  232,  190,    0,   57,  923
1720 DATA   22,  149,    3,  117,    4,  138,   38,  184,  655
1730 DATA    3,  232,  162,    0,   66,  131,  199,    6,  799
1740 DATA  226,  219,  195,  198,    6,  182,    3,    2, 1031
1750 DATA  198,    6,  181,    3,    2,  232,  175,  255, 1052
1760 DATA  161,  149,    3,  179,    6,  246,  227,    3,  974
1770 DATA  248,  139,  115,    4,    3,  245,  138,   38,  930
1780 DATA  183,    3,  232,  121,    0,  195,   50,  228, 1012
1790 DATA  205,   22,  195,  139,   30,  149,    3,  139,  882
1800 DATA   14,  153,    3,   73,  128,  252,   77,  117,  817
1810 DATA    9,   67,   59,  217,  118,   14,   51,  219,  754
1820 DATA  235,   10,  128,  252,   75,  117,   10,   75,  902
1830 DATA  121,    2,  139,  217,  137,   30,  149,    3,  798
1840 DATA  195,  128,  252,   71,  116,  232,  128,  252, 1374
1850 DATA   79,  116,  239,  232,   53,    1,  195,   60,  975
1860 DATA   97,  114,    6,   60,  122,  119,    2,   44,  564
1870 DATA   32,  195,   60,   27,  117,    4,  176,  255,  866
1880 DATA  248,  195,  139,  216,  161,  149,    3,  128, 1239
1890 DATA  251,   13,  116,  244,   51,  210,  139,   14, 1038
1900 DATA  153,    3,  232,   58,  255,  139,  115,    2,  957
1910 DATA    3,  245,  172,   58,  195,  116,    8,   66,  863
1920 DATA  131,  199,    6,  226,  240,  249,  195,  139, 1385
1930 DATA  194,  163,  149,    3,  235,  210,  172,   10, 1136
1940 DATA  192,  116,    9,  232,    7,    0,  254,    6,  816
1950 DATA  181,    3,  235,  242,  195,   80,   83,   81, 1100
1960 DATA  232,   37,    0,  185,    1,    0,  138,  220,  813
1970 DATA  180,    9,  138,   62,   91,    1,  232,   13,  726
1980 DATA  252,   89,   91,   88,  195,  184,    0,    6,  905
1990 DATA  181,    1,  182,    2,  177,    1,  178,   78,  800
2000 DATA  138,   62,  183,    3,  232,  247,  251,  195, 1311
2010 DATA   80,   83,   82,  139,   22,  181,    3,  180,  770
2020 DATA    2,  138,   62,   91,    1,  232,  230,  251, 1007
2030 DATA   90,   91,   88,  195,   83,   81,  139,   14,  781
2040 DATA  155,    3,  139,  217,  129,  233,  104,   11,  991
2050 DATA  129,  249,    0,    2,  116,    7,  137,    7,  647
2060 DATA  131,    6,  155,    3,    2,   89,   91,  195,  672
2070 DATA   80,   81,   86,  198,    6,  182,    3,    2,  638
2080 DATA  198,    6,  181,    3,    1,  232,  192,  255, 1068
2090 DATA  184,   32,   10,  138,   62,   91,    1,  185,  703
2100 DATA   78,    0,  232,  169,  251,  190,  104,   13, 1037
2110 DATA  139,  206,  129,  233,  104,   13,  232,  167, 1223
2120 DATA  255,  232,  242,  254,   10,  192,  116,  240, 1541
2130 DATA   60,   13,  116,   66,   60,   27,  116,   55,  513
2140 DATA   60,    8,  116,   24,  129,  249,  152,    0,  738
2150 DATA  119,   22,  137,    4,  131,  198,    2,  138,  751
2160 DATA   38,  183,    3,  232,   87,  255,  254,    6, 1058
2170 DATA  181,    3,  235,  204,   11,  201,  117,    5,  957
2180 DATA  232,   48,    0,  235,  195,  131,  238,    2, 1081
2190 DATA  254,   14,  181,    3,  176,   32,  138,   38,  836
2200 DATA  183,    3,  232,   56,  255,  235,  177,   11, 1152
2210 DATA  201,  117,  144,  249,  235,   17,   11,  201, 1175
2220 DATA  116,   12,  209,  233,  190,  104,   13,  252, 1129
2230 DATA  173,  232,   96,  255,  226,  250,  248,   94, 1574
2240 DATA   89,   88,  195,   80,  184,    7,   14,  232,  889
2250 DATA   52,  251,   88,  195,   47,  110,   32,   84,  859
2260 DATA  111,  111,   32,   66,  105,  103,   36,   70,  634
2270 DATA  105,  108,  101,   32,   84,  111,  111,   32,  684
2280 DATA   66,  105,  103,   36,   69,  114,  114,  111,  718
2290 DATA  114,   32,   79,  112,  101,  110,  105,  110,  763
2300 DATA  103,   32,   70,  105,  108,  101,   36,   85,  640
2310 DATA  115,   97,  103,  101,   58,   32,   83,   76,  665
2320 DATA   65,   83,   72,   66,   65,   82,   32,   91,  556
2330 DATA  112,   97,  116,  104,   93,  109,  101,  110,  842
```

Fig 2 A Basic program that will automatically create SLASHBAR.COM when it is run once

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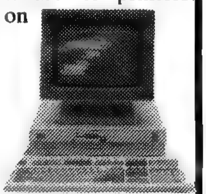

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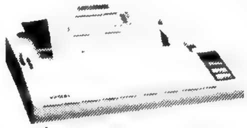

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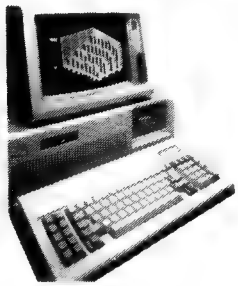

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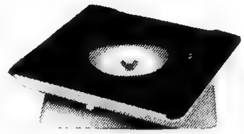

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```
2340 DATA 117, 110,  97, 109, 101,  46, 101, 120,  801
2350 DATA 116,  32,  91,  47, 110,  93,  36, 186,  711
2360 DATA   3,   1, 180,   9, 205,  33, 232,  67,  730
2370 DATA   1, 199,   6,   0,   1,   0,   0, 199,  406
2380 DATA   6,   2,   1,   0,   0,  51, 219, 140,  419
2390 DATA 200,  67, 142, 195,  59, 195, 116,  16,  990
2400 DATA 190,   0,   1, 139, 254, 185,  16,   0,  785
2410 DATA 243, 167,  11, 201, 117, 235, 235,  70, 1279
2420 DATA 191, 128,   0, 130,  13,  50, 237,  71,  828
2430 DATA 176,  47, 242, 174, 227,  56, 139, 247, 1308
2440 DATA  79, 198,   5,  13, 191,  10,   0, 185,  681
2450 DATA   5,   0,  51, 219, 172,  44,  48,  60,  599
2460 DATA   9, 119,   9, 147, 247, 231,  50, 255, 1067
2470 DATA   3, 216, 226, 240, 137,  30, 147,   3, 1002
2480 DATA  51, 192,  72,  43, 195,  61, 128,  14,  756
2490 DATA 119,  12, 186,  36,   7, 180,   9, 205,  754
2500 DATA  33, 184,   1,  76, 205,  33, 190, 129,  851
2510 DATA   0, 172,  60,  32, 116, 251,  60,  13,  704
2520 DATA 117,   5, 186,  79,   7, 235, 230, 139,  998
2530 DATA 214,  74, 172,  60,  32, 116,   4,  60,  732
2540 DATA  13, 117, 247,  78, 198,   4,   0, 184,  841
2550 DATA   0,  61, 205,  33, 115,   5, 186,  60,  665
2560 DATA   7, 235, 202, 139, 216, 184,   2,  66, 1051
2570 DATA  51, 201,  51, 210, 205,  33, 114, 238, 1103
2580 DATA  59,   6, 147,   3, 118,   5, 186,  47,  571
2590 DATA   7, 235, 178,  80, 184,   0,  66,  51,  801
2600 DATA 201,  51, 210, 205,  33,  89, 114, 214, 1117
2610 DATA 180,  63, 186, 128,  14,  30,   6,  31,  638
2620 DATA 205,  33,  31, 114, 201, 180,  62, 205, 1031
2630 DATA  33, 140, 201, 140, 195,  59, 203, 116, 1087
2640 DATA   5, 184,   0,  76, 205,  33,   6, 180,  689
2650 DATA  52, 205,  33, 137,  30,  85,   1, 140,  683
2660 DATA   6,  87,   1,   7, 176,   9, 191,  73,  550
2670 DATA   1, 186,  98,   1, 232,  95,   0, 176,  789
2680 DATA  22, 191,  77,   1, 186,  69,   3, 232,  781
2690 DATA  84,   0, 176,  33, 191,  81,   1, 186,  752
2700 DATA  24,   3, 232,  73,   0, 161,  44,   0,  537
2710 DATA 142, 192, 180,  73, 205,  33, 186, 143, 1154
2720 DATA  14,   3,  22, 147,   3, 177,   4, 211,  581
2730 DATA 234, 184,   0,  49, 205,  33,  83, 108,  896
2740 DATA  97, 115, 104,  66,  97, 114,  58,  32,  683
2750 DATA  82, 101, 113, 117, 105, 114, 101, 115,  848
2760 DATA  32,  68,  79,  83,  32,  50,  46,  48,  438
2770 DATA  43,  13,  10,  36, 180,  48, 205,  33,  568
2780 DATA  60,   2, 115,   9, 186, 166,   8, 180,  726
2790 DATA   9, 205,  33, 205,  32, 195,   6,  80,  765
2800 DATA 180,  53, 205,  33, 137,  29, 140,  69,  846
2810 DATA   2,  88, 180,  37, 205,  33,   7, 195,  747
```

lates a menu command into a series of keystrokes. Up to 256 keys may be stored for any single menu command. To pass these keys to the application program INT 16h, the BIOS keyboard interrupt, is used. (Don't confuse this with INT 9, which is a hardware interrupt generated by the keyboard controller.) INT 16 is a software interrupt used to remove keys from the BIOS buffer located in low memory. To prevent menu keys from being mixed with keys that may already be in the buffer, SLASHBAR will not pop up unless the BIOS keyboard buffer is empty.

The DOS Critical Flag

Resident programs that interrupt DOS at the wrong moment can put a lot of wear on the big red switch. To prevent SLASHBAR from being more trouble than it is worth, an undocumented (that is, unsupported) DOS function is used to obtain the address of the 'DOS Critical Flag'. This is a 1-byte area in low memory that DOS uses to signal that it is inside an INT 21h function call and should not be interrupted. I've personally tested the function call successfully in all PC-DOS versions from 2.0 to 3.2. Although not listed in the IBM *Technical Reference* manual, this call has been mentioned in the *Microsoft Systems Journal* (Volume 1 Number 2) as part of the long-awaited TSR standard. The address of the Critical Flag is retrieved and saved when SLASHBAR is installed. Each time the hot-key combination is pressed, this byte is checked for a busy signal.

Making a decision to pop up based on the critical flag alone, however, would mean that SLASHBAR would not pop up inside programs that use the DOS keyboard input functions. These include DEBUF, EDLIN, and DOS itself. Clearly, such a restriction would be too severe, and fortunately it is really unnecessary. Because of the way that DOS operates internally, other functions can continue with no ill effects while INT 21h functions 01h through 0Ch are active. By splicing into the DOS INT 21h function call, we can set an internal flag, LO_FN_FLAG, to nonzero when DOS is using one of these interruptible function calls. If the DOS Critical Flag is set but the LO_FN_FLAG is set as well, SLASHBAR proceeds to pop up.

The interception of an interrupt is usually transparent to the system. INT 21h is an exception. Function 0, the old-style 'Program terminate', requires that the CS register contain the segment of the Program Segment Prefix for the program to be terminated. The CS value is determined by checking the value pushed onto the stack by the INT instruction. By intercepting INT 21h, SLASHBAR changes the CS value passed to the function handler. The program-terminate call fails and causes DOS to halt with a memory allocation error. SLASHBAR bypasses this problem by substituting the newer function 4Ch, 'Terminate a process', for function 0. This substitution produces the same effect as the original function and is transparent.

Video handling

SLASHBAR is designed to function in the normal video-text modes of the PC and will not pop up in a graphics mode. This restriction was imposed to keep the program small, but ambitious programmers could modify the assembly language listing to provide this capability. SLASHBAR will, however, pop up in the 40-column text modes of the colour/graphics adaptor (CGA). This was allowed to accommodate users who have used mode 0 or 1 to invoke a special EGA mode.

If all goes well up to this point, SLASHBAR is ready to pop up on the screen. The current stack segment and stack pointer (SS and SP registers) are saved in local memory and switched to point to an internal stack. There's an important reason for this step. SLASHBAR uses the BP register as a pointer to the start of the compiled menu file. By default, the 8088 uses SS to calculate all references to BP. When SLASHBAR is resident, however, we want all references relative to the CS register, which points to the segment that contains the code and data. By setting SS to point to the same segment as CS, we can use the BP register without worrying about segments.

To achieve maximum compatibility, all of SLASHBAR's screen handling is performed through the BIOS Video Service, INT 10h. This interrupt is not invoked directly but is made by calling the VIDEO procedure. Some older versions of the IBM BIOS change the value of the BP register during certain video functions. By surrounding the interrupt with a PUSH BP/POP BP pair of instructions, potential problems are eliminated. The current cursor location and video page are saved in local storage. Then, the SCREEN procedure is used to save the portion of the screen that will be overwritten.

The SCREEN procedure serves a dual purpose and takes advantage of the similarity between the save and restore operations to minimise the size of the code. The contents of the SI and DI registers determine if a screen save or restore is to be performed. The workhorses of the procedure are the BIOS video functions 8 (Get character and attribute) and 9 (Write character and attribute).

Register usage

The .BAR file format is designed to make it easy for SLASHBAR to ex-

ecute. To this end, certain registers are assigned dedicated uses throughout the program. The BP register always contains the absolute location in the segment of the beginning of the .BAR script, for example. Because all addresses in the script are offsets from the beginning, the real address of the item can be found by adding the offset to the value in the BP register. The DI register is used to hold the offset of the current menu header. Care is taken across procedure and function calls to preserve these registers.

The Intel 8088 family also endows certain registers with special characteristics. When calculating an effective address, only the BP, SI, DI, and BX registers may be used. The registers may be used in almost any combination except that the BX register cannot be used with the BP register. So, for example, if BP contains the location of the beginning of the BAR script (BP = 1234h), and SI contains the offset of a menu from the beginning of the script (SI = 0104h), [BP+SI] refers to the absolute location of that menu in the segment (1338h). (The brackets indicate that the value is not BP + SI but the contents of the location pointed to by BP + SI and may also be written [BP][SI].)

As options are chosen that cause submenus to be displayed, the offsets of the previous menus are saved in the MENU_STK array in much the same way as a return address is saved during a subroutine call. Should there be a need to back out of a menu, the previous menu offset is loaded from MENU_STACK and execution continues at that point. The LEVEL variable is used as an index to determine the current menu address.

Because executing a menu option may have caused keys to be stored in the KEYS buffer, the location of the last valid character is similarly stored in the KEY_STK array. KEY_PTR is restored to this value in the same way as is the menu address. Thus, backing out of a menu erases any added keystrokes.

Several arrays and variables are initialised on entry to the MENU_TIME procedure. The address of the first menu is placed in MENU_STK and the name of the menu, as stored in the .BAR file, is written in the corner of the window.

Screening menus

Building the menu on screen is a straightforward procedure when broken down into logical steps. The inside of the dialogue box is cleared using the CLR_LINES procedure. Then, using the LEVEL variable, the offset of the current menu header is loaded into the DI register. Fig 3 shows the format of the menu header. The word at [BP][DI] contains the number of options in the menu and is stored in NOPT.

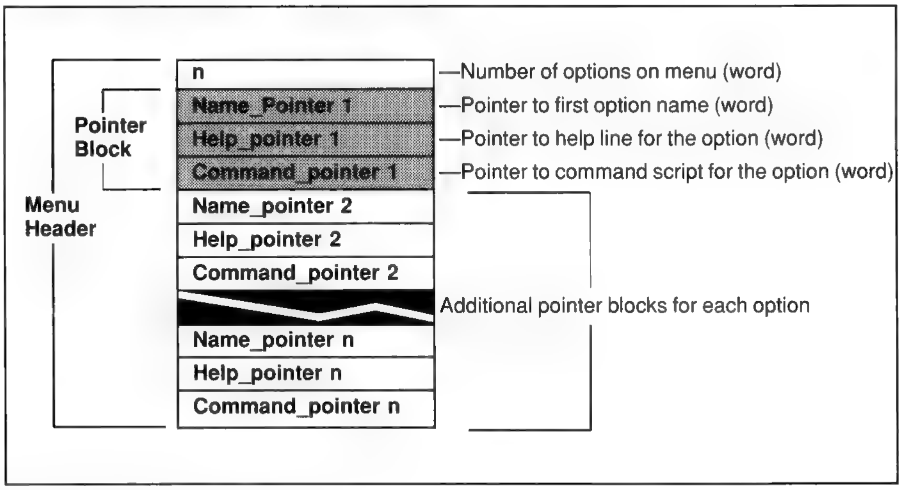


Fig 3 Format of menu header

The WRITE_NAMES procedure steps through the header to find and display the option names on the first line of the window. The option pointed to by the OPT_PTR variable is displayed in reverse video or distinctive colours. WRITE_HELP is called next to display the help line for the option highlighted on the screen. With the menu now constructed, GET_KEY is called to wait for input from the keyboard.

There are two valid ways of selecting an option. The cursor bar can be moved with the Home, End, and Left or Right Arrow keys. The positioning of the cursor bar is handled by the MOVE_BAR procedure, which keeps track of the current option, updates the OPT_PTR variable, and wraps the cursor when it gets to either side of the menu.

If GET_KEY returns an ASCII key, the value is converted to uppercase by MAKE_UC. MATCH_KEY is then called to interpret the key. The Esc key is used to back the menu by one level. This is signalled by returning FFh in AL. If the menu is currently at the top level, the window is closed and control returns to the application. The Enter key has the opposite effect, causing the number of the current option to be return in AL. Finally, the first letter of the option names are scanned, from left to right, to find a match. If a match is found, the number of the option is returned in AL. The carry flag is set if no match is found; otherwise, it is cleared.

When an option is selected, the offset of the command script is determined from the menu header and the interpretation of the commands begins. SI is used to point to the real address of the script in memory so that instructions and data can be retrieved with the LODSB and LODSW instructions. A byte containing a command token is read from the script and then used as an index into a jump table. Invalid token values pass control over to an error routine that exits the menu. Other token values pass over to routines that implement specific functions. Each function other than EXECUTE and SEND returns to read the next instruction.

The ASK command clears the menu window and copies characters from the script to the screen until a zero byte is read. The CR command places the code for the Enter key into the KEYS buffer. It is really a special case of the TYPE command. TYPE is more general and copies characters from the script to the KEYS buffer until a zero byte is read. To save space and simplify the translation, the scan codes for ASCII characters, normally returned by the BIOS and AH, are not placed in the .BAR file. When the characters are read by TYPE and placed in the KEYS buffer they are expanded to 2 bytes to mimic the information returned by INT 16h. The upper byte is set to zero.

(While testing SLASHBAR, I found only one application program that made use of the upper byte. When the Return, Esc, Backspace, or Tab characters were placed in the buffer with the high byte at zero, Word Perfect interpreted them as characters instead of control keys. So for those four keys, a value for the scan code is placed in the high byte.)

SLASHBAR at a glance

SLASHBAR is a memory-resident utility that provides a pop-up window and interpreter for a Lotus-style control menu. The menu is intended to contain the commands needed to run non-Lotus applications programs. Menus must be prepared in the format described in and compiled using the MAKEBAR.COM program presented in last month's issue.

The syntax for SLASHBAR is

SLASHBAR [path]menuname.ext [/n]

where menuname.ext is the name of the compiled bar-menu file (which usually has a .BAR extension). When SLASHBAR is first loaded, the /n parameter (in bytes) is used to reserve sufficient room in memory for the largest .BAR file that will be used during the current session. The default value for /n is 4096 bytes, and its upper limit is approximately 60k, which is more than the largest .BAR file that can be produced by the MAKEBAR compiler.

The Alt-/key combination is used to activate the pop-up menu.

The INPUT command performs buffered keyboard input from the keyboard and displays the characters on the second line of the window as they are typed. Characters can be erased one at a time with the Backspace key, and the entire line can be cleared by pressing Esc.

An option block can terminate in either of two ways. The first is with an EXECUTE command. This transfers control to a new menu. The LEVEL is incremented and the old menu offset and KEY_PTR are saved on their stacks. The new menu is built on the screen and then the process continues.

The second way an option block can end is when the SEND token is read from the script file. SEND is a BDF command code inserted in the .BAR file by the compiler to tell SLASHBAR that the menu command is complete and the buffered keystrokes should be sent to the application program. The SEND routine checks to see if the buffer is empty, and, if so, exists the menu with no further action.

Many keyboard enhancement programs use the Hardware Timer Tick interrupt (INT 8) to periodically check the BIOS keyboard buffer and add or modify keystrokes. Intercepting INT 8, however, has some inherent problems associated with it. Because the timer tick occurs approximately 18.2 times each second, the time spent servicing the interrupt can have a measurable effect on the effective speed of your PC. (Several programs designed to slow the AT down to XT speed for game playing do nothing more than waste time inside INT 8.) Thus, SLASHBAR uses a slightly different approach and avoids using INT 8 at all.

The INT_16 procedure in the SLASHBAR program is designed to work in conjunction with the BIOS INT 16h as a 'data switch'. The BIOS INT 16h call has three functions. When AH=2, the BIOS returns the status to the Shift keys. This request is always made with a FAR JUMP.

When AH=1, the calling program wants to know if any keys are in the buffer. This call is usually made so that if there aren't any keys ready, other actions can be performed. The AH=0 function causes the BIOS either to return the next available key from the buffer or to enter a wait loop until a key is pressed. Each time an INT 16h is executed with AH=0 or AH=1, SLASHBAR checks to see if there are any keys stored in the KEYS buffer. If there are, they are fed to the calling program and the BIOS routine is never invoked. When the KEYS buffer is empty, the requests are passed through to the BIOS as normal. When SLASHBAR is active, all keyboard function requests are passed through to the BIOS. If they weren't, SLASHBAR would read the characters put into the KEYS buffer as responses to its own request for input.

The only problem with this approach arises when SLASHBAR's INT_16 procedure has keys available and is waiting for an INT 16 call to request them, *and* the BIOS is already inside an INT 16. If no key is ready when the wait-for-key call is made, the BIOS enters a wait loop that checks the BIOS keyboard buffer periodically to see if an INT 9 has placed any keys in it but does not issue another INT 16. The result is a stalemate.

Pump priming

SLASHBAR breaks the deadlock by priming the pump, so to speak. If the last call made to the BIOS before SLASHBAR became active was AH=0 (Wait-for-key), the first key of the string built by SLASHBAR is placed in the BIOS keyboard buffer with interrupts disabled. When interrupts are reactivated the BIOS detects it, exits its wait loop and returns the key to the calling application. All further INT 16h calls remove keys from the KEYS buffer until it has been emptied. If the BIOS call was AH-1, however, the last key in the SLASHBAR string is placed in the BIOS buffer. Only when these are exhausted will the INT_16 routine allow the application to fetch the final key from the BIOS.

After placing the single key in the BIOS buffer, control returns to the INT_9 procedure where the SCREEN procedure is called to restore the information on the monitor. The original stack segment and pointer registers (SS and SP) are swapped back and control is relinquished to DOS.

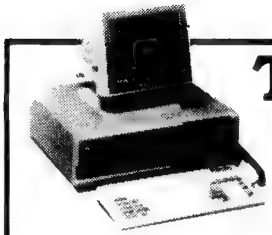
Conclusion

If you've traced through the .ASM listing while reading the latter part of this column, you have, I hope, learned some useful programming techniques. Regardless of your degree of interest in assembly language, however, you can see that SLASHBAR represents a simple, easy-to-use interface that you can add to almost any application program. The interface is programmable and flexible enough to be used by itself as a menu to execute other application programs. In combination with the companion MAKEBAR compiler discussed last month, it represents a complete programming system that can point the way toward making applications more useful by standardising their user interface.

END

SLASHBAR.BAS, whether typed in from the magazine at your keyboard, obtained from APC's Sydney office or downloaded from Microtex, will automatically create SLASHBAR.COM when run once in Basic. SLASHBAR.ASM, also listed both here and on Microtex, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft) and the commands:

MASM SLASHBAR;
LINK SLASHBAR;
EXE2BIN SLASHBAR SLASHBAR.COM



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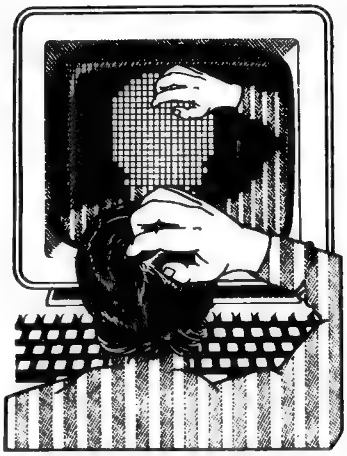

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Mac works

While in the spreadsheet, you can quickly move a selected range of cells by holding down the Command and Option keys while clicking in an empty cell. The cell that is clicked in will be the upper left cell of the moved range.
John Stoneham

Flight simulator

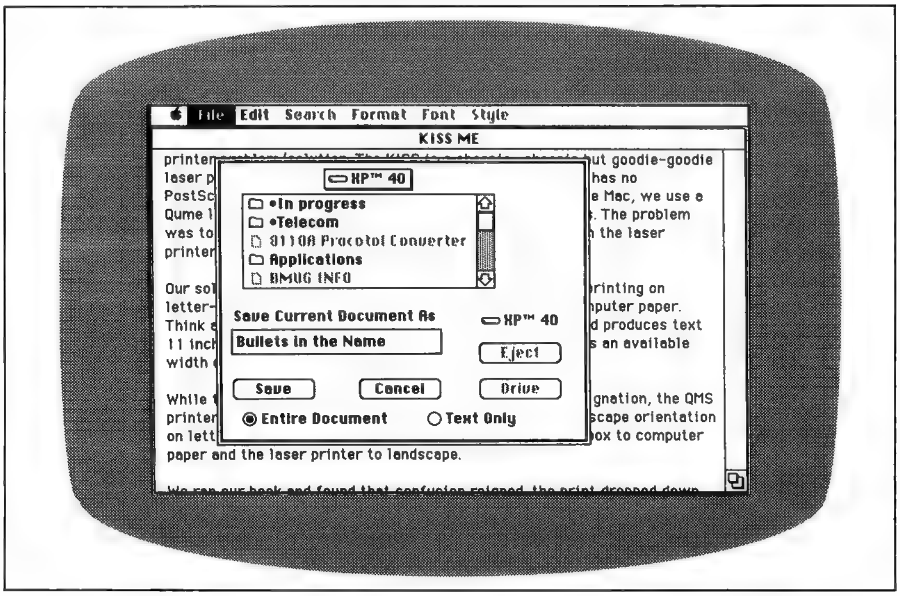
It is possible to activate five prerecorded situations on the Mac version of Flight Simulator that do not normally appear, by using an undocumented technique. Start by choosing LOAD RAM FROM DISK from the Situation menu. The Flight Simulator disk will eject and you will be prompted to insert a disk containing a situation file. Instead, reinsert the Flight Simulator disk. In a few seconds a confused Flight Simulator will eject the disk and you will be prompted to reinsert it. You can now access situations you previously couldn't obtain.
Lawson Stone

Diskettes

A solution to those messy 3.5in disk labels that you always want to change is to place Scotch Magic Transparent Tape over the disk labels. Write all the labels in a number 2 pencil. Later, when the label is to be changed, carefully erase the tape (brushing upwards to avoid getting the eraser residue near the disk sliding cover).
William Reynolds

Finder

There is often a Mac file or folder that you wish to be able to access quickly when using the OPEN command from an application, instead of having to scroll to find it. Add a bullet (Option-8) as a prefix to a file's name and the file or folder will always appear at the top of the list of files.
Robert Spofford



Placing a bullet (Option-8) in front of the name of a file or folder will place it at the top of the standard file dialogs (such as Save As, in this case)

Formal date notation

It would be nice to be able to make dates appear in 1-2-3 in the conventional format of July 4, 1987 rather than the informal style of 4-Jul-87. I've written a macro, shown in Fig 1, that writes today's date in a more formal style. The formula covers several lines in the figure, but it should, of course, be entered continuously into a single cell.
Barry DeGraff

If you put a cell address in the formula instead of @@@now, the formula will display the date corresponding to whatever number is in the referenced cell. However, any number that should give you a date before 1910 will be displayed incorrectly. 1901 will display as 191, 1905 as 195, etc, because the @year function does not return leading zeros — JT.

```
@CHOOSE(@VALUE(@MONTH(@NOW)),"","JANUARY","FEBRUARY","MARCH","APRIL","MAY",
"JUNE","JULY","AUGUST","SEPTEMBER","OCTOBER","NOVEMBER","DECEMBER")&" "&
@STRING(@DAY(@NOW),0)&", 19"&@STRING(@YEAR(@NOW),0)
```

Fig 1 A 1-2-3 formula that displays today's date in formal notation

TJ'S WORKSHOP

```
WITHOUT  {windowsoff}  {paneloff}  or  {blank}        39 Seconds
  With   {windowsoff}                                 23
  With   {windowsoff}  and  {paneloff}                21
  With   {windowsoff}  {paneloff}  and  {blank}       10
```

Fig 2 Speed tests of the same macro when run with and without certain commands

Speeding up macros

There are several ways to speed up Lotus 1-2-3 macros. One is to use the Release 2 command {blank} instead of the Release 1A routine, /Range Erase. Instead of /reA1~ use {blank A1}, and instead of /reOLDDATA~ use {blank OLDDATA}. I have a macro that has 24 erase commands that are used to update a worksheet before new data entry. I timed its operation with and without {windowsoff}, {paneloff}, and {blank}, and obtained the results shown in Fig 2. I have also found that macros execute more quickly if you use the {branch} key word rather than the old /xg command.

Gerard Tan

That's quite a speedup Mr Tan reports for the last example, just by using {blank} instead of /re. When I clocked a few test macros I didn't get anywhere near that much improvement, but the {blank} macros definitely ran more quickly. For those of us who got started on Release 1A, it's sometimes hard to break old habits, but the newer equivalents in Release 2 are generally faster. I no longer use the old /x commands unless I need to write macros that are 1A compatible — JT.

Monitor sniffer

One of the biggest problems I have had in managing a Novell network is mapping the directories containing the correct video drivers for programs like Lotus 1-2-3. The users on my network might be on a PC with a colour card and then might switch to a Hercules card a minute later. This makes it difficult to map the directories containing the video drivers, based on which user has access to which PC. The next logical step is to map the directory containing the video drivers based on the video adaptor inside the PC itself.

The MONCHECK.BAS compiled Basic program in Fig 3 checks for the presence of a Compaq graphics adaptor, Enhanced Graphics Adaptor, a Colour/Graphics Adaptor, a Hercules monochrome/graphics adaptor, or a monochrome adaptor (every possible video adaptor installed on our Novell SFT Advanced/286 network).

Alex Perez

```
100 'MONCHECK.BAS -- identifies monitor -- by Alex Perez
110 CLS:LOCATE 1,1,0
120 '
130 ' Check if Compaq by reading "COMPAQ" at FFFE:000A
140 ' Then check if this CPU has an EGA adapter
150 '
160 DTSG=&HFFFE:DTA$="COMPAQ":DLC=&HA:GOSUB 430
170 IF DTA$=DTARD$ THEN CPU$="COMPAQ"
180 '
190 ' Check for EGA by reading "IBM" at C000:001E
200 ' If no EGA then check the value of CPU$
210 ' If value = "COMPAQ" then COMPAQ, otherwise keep checking
220 '
230 DTSG=&HC000:DTA$="IBM":DLC=&H1E:GOSUB 430
240 IF DTA$=DTARD$ THEN MON$="n EGA":GOTO 390
250 IF CPU$="COMPAQ" THEN MON$="COMPAQ":GOTO 390
260 '
270 ' Check if mono or color by reading motherboard switches
280 ' If mono then check for hercules or plain monochrome
290 '
300 DEF SEG=0:IF (PEEK(&H410)AND &H30)<>&H30 THEN MON$=" CGA":GOTO 390
310 '
320 ' Read and isolate the 7th bit of I/O port &H3BA
330 ' If it changes then Hercules; if not assume plain mono
340 '
350 A=(INP(&H3BA)AND &H80):T=TIMER
360 IF T+1 =< TIMER THEN MON$=" Mono":GOTO 390 ELSE B=(INP(&H3BA)AND &H80)
370 IF B<>A THEN MON$=" Hercules":GOTO 390 ELSE 360
380 '
390 PRINT "You have a";MON$:END
400 '
410 '          SUBROUTINE FOR READING DATA FROM SYSTEM ROM
420 '
430 DTARD$="":DEF SEG=DTSG:FOR I=1 TO LEN(DTA$)
440 RD=PEEK((DLC-1)+1):DTARD$=DTARD$+CHR$(RD)
450 NEXT I:DEF SEG:RETURN
```

Fig 3 Program that detects the type of monitor being used

Mr Perez's submission contained a complicated method for selecting drivers, at the heart of which was a cascade of statements:

```
520   MON$="MNO":GOTO 570
530   MON$="CPQ":GOTO 570
540   MON$="CLR":GOTO 570
550   MON$="EGA":GOTO 570
560   MON$="HRC"
570   SHELL "MAP "+COM-
      MAND$+MON$=" > NUL:"
      END
```

Each test jumped to the appropriate line in the cascade (for example, if the program found an EGA, it jumped to line 550). Then the program used the DOS SHELL command to pass the appropriate driver code to the NetWare MAP command. It uses the QB2 COMMAND$ function, so don't try it in interpretive Basic.

The program also assumes that certain copyright messages will be at certain absolute addresses. This is not the case with nonstandard video boards, and even mainstream manufacturers have been known to move or change their copyright message locations and content, to the consternation of users.

Would it really have been so hard for IBM to have roped off one memory location for monitor type? No. Did they? What do you think? — PS.

Kicking the pipe habit

Pipes should be avoided when they are not needed because MS-DOS, being single-tasking, must create an intermediate disk file to pass the data between programs. A pipe can add substantially to the execution time of a batch file. You can verify this by running SCANBAT1.BAT and READ1.BAT in Fig 4, and then SCANBAT2.BAT and READ2.BAT in Fig 5. Once you've created them, type SCANBAT1 and SCANBAT2.

Carl Bergerson

This not only speeds things up, but does away with those odd piping artifacts in the directory with names like 1608091F and 16080924 — PS.

Enhanced keyboard codes

I have redefined several function keys on my IBM PC keyboard using ANSI.SYS. When I tried to find the scan codes for the F11 and F12 keys on the AT's enhanced keyboard, however, I couldn't get them. My dealer queried IBM and found out the codes were 122 and 123, but these still don't work. Is there a way to redefine F11 and F12?

Jim Kinney.

```
rem scanbat1.bat
echo off
for %%f in (*.bat) do command /c read1 %%f

rem read1.bat
echo off
cls
echo %1
type %1 | more
pause
```

Fig 4 Original slow batch-scanning files that use pipes

```
rem scanbat2.bat
echo off
for %%f in (*.bat) do command /c read2 %%f

rem read2.bat
echo off
cls
echo %1
more <%1
pause
```

Fig 5 Improved fast batch-scanning files that avoid pipes

```
N NEWKEYS.COM
A
JMP     013A         ; Jmp Initialize
DW      0,0
CMP     AH,00        ; NewInt16:
JZ      0115         ; Jmp GetKey
CMP     AH,01
JZ      0121         ; Jmp GetStatus
CS:
JMP     FAR [0102]   ; Jmp OldInt16
MOV     AH,10        ; GetKey:
PUSHF
CS:
CALL    FAR [0102]   ; Call OldInt16
CALL    0131         ; Call FixUp
IRET
MOV     AH,11        ; GetStatus:
PUSHF
CS:
CALL    FAR [0102]   ; Call OldInt16
JZ      012E

CALL    0131         ; Call FixUp
RETF    0002
CMP     AL,E0        ; FixUp:
JNZ     0139
SUB     AL,AL
CMP     AL,01
RET
MOV     AX,3516      ; Initialize:
INT     21           ; Get OldInt16
MOV     [0102],BX    ; Save it
MOV     [0104],ES
MOV     DX,0106
MOV     AX,2516
INT     21           ; Set NewInt16
MOV     DX,013A
INT     27           ; Stay Resident

R CX
54
W
Q
```

Fig 6 This DEBUG script file creates a remain-resident program called NEWKEYS.COM that lets DOS use the new keyboard codes defined for the IBM enhanced keyboard

You were misinformed — the codes for the F11 and F12 keys are actually 133 and 134. However, don't rush off and try them just yet. There's a catch.

When IBM designed the BIOS support for the enhanced keyboard, they added over 30 new extended keyboard codes, starting at 133. However, they did not make these keyboard codes available to programs through the normal BIOS keyboard interface. To do so would have created incompatibilities with some existing programs. For instance, some keyboard macro programs define their own extended keys and these may conflict with the new IBM codes.

DOS (and most programs) get keyboard information from the BIOS through interrupt 16h, function calls 0, 1 and 2. For the enhanced keyboard, IBM defined new function calls numbered 10h, 11h and 12h that duplicated 0, 1 and 2, except that the new calls also return the new extended keyboard codes in addition to the old ones.

Fig 6 shows a DEBUG script for a NEWKEYS.COM program you can create that allows DOS access to the new codes and thus allows you to use these new keys with ANSI.SYS. You can create NEWKEYS.COM by typing the lines shown into a file called NEWKEYS.SCR. (You don't need to type the semicolons or the comments that follow them.) Then execute

DEBUG<NEWKEYS.SCR

This creates NEWKEYS.COM. NEWKEYS.COM is a terminate-and-stay-resident program, so it need be loaded only once during your PC session. Like most TSRs, it may have some compatibility problems with other programs. If everything seems to work okay once you load it, then you're probably in good shape.

When NEWKEYS is loaded, you can use the extra keyboard codes for ANSI.SYS redefinitions. The new codes are shown in Fig 7. (The old codes can be obtained from the IBM Basic manual.) For instance, the ANSI sequence for redefining the F11 key to do a DIR command is

<Esc>[0;133;"DIR";13p

— CP.

Password

The program below lets you keep others out of the programs and files on your Apple DOS 3.3 disk. Use POKE 21503,0 to disable the catalog on a DOS 3.3 disk if the password is not correct. To change the password, change lines 30, 40 and 55 from TRIPLE BOGIE to the password desired. Just save it under the boot program's name.
Mike Horak

```
10  HOME : PRINT "WHAT IS
    THE CODE WORD?"
20  INPUT A$
30  HOME : IF A$ < > "TRIPLE
    BOGIE" THEN POKE - 21503,0
40  IF A$ = "TRIPLE BOGIE"
    THEN PRINT "HELLO MIKE"
50  PRINT : PRINT : PRINT :
    PRINT : PRINT : PRINT :
    PRINT
55  IF A$ < > "TRIPLE BOGIE"
    THEN ONERR GOTO 70
60  PRINT CHR$ (4);"CATALOG"
70  NEW
```

Extended Code	Key	Extended Code	Key
133	F11	149	Ctrl /
134	F12	150	Ctrl *
135	Shift F11	151	Alt Home
136	Shift F12	152	Alt Up-Arrow
137	Ctrl F11	153	Alt Page-Up
138	Ctrl F12	155	Alt Left-Arrow
139	Alt F11	157	Alt Right-Arrow
140	Alt F12	159	Alt End
141	Ctrl Up-Arrow	160	Alt Down-Arrow
142	Ctrl -	161	Alt Page-Down
143	Ctrl 5	162	Alt Insert
144	Ctrl +	163	Alt Delete
145	Ctrl Down-Arrow	164	Alt /
146	Ctrl Insert	165	Alt Tab
147	Ctrl Delete	166	Alt Enter
148	Ctrl Tab		

Fig 7 IBM's new extended keyboard codes for the enhanced keyboard

IIGS on-screen clock

The following utility program reads the IIGS clock and puts the time and date in variable T$, which you can display or manipulate by using MID$, LEFT$, etc. Other strings can be concatenated with T$. Just don't try to redefine T$, and be sure that it's the first statement in your program. If you run the program, this statement won't look right because it now holds the time/date last displayed, which tokenises into Applesoft commands such as COLOR=. You can also poke the time and date directly to the screen. Try changing 9,8 to 50,6. Doing so sends the output to $0632 on the screen page instead of $0809 in the Applesoft program. You can also change the format with open-apple/Control/Esc as you're running the program.

David Hill

```
10  T$ = "MO/DY/YR HR/MI/SE
    SM": HOME : FOR I=0 TO 19:
    READ J: POKE 768 + I,J:
    NEXT : DATA
    24,251,194,48,244,0,0,244,9,
    8,162,3,15,34,0,0,225,56,251,96
20  CALL 768: VTAB 5: HTAB 5:
    PRINT T$:KB = PEEK
    (49152): IF KB < 128 THEN 20
```

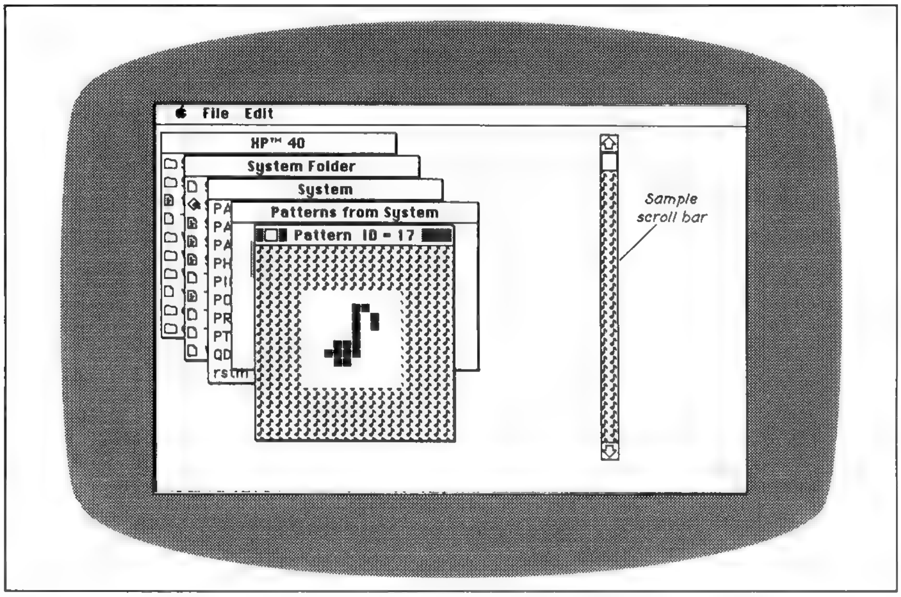
Getting to point mode

When you edit a formula in 1-2-3, it's often easier to re-enter cell references by pointing to them rather than by typing cell addresses. This is especially true if you can't tell what the addresses are because the cells are off the screen. But once you have hit F2 and are in Edit mode, how do you then get into Point mode?

If you want to change the last cell reference in the formula, backspace over it so that the formula ends with an arithmetic operator (+,*,etc.), a comma, or an open parenthesis. Now, when you hit the Up or Down Arrow key, the cursor will move to the next cell and you'll be in Point mode. To move the pointer right or left, you still have to use the Up or Down Arrow key to get into Point mode first.

John Predmore

The programmer who included this escape from Edit mode must have forgotten to explain it to whoever wrote the manual. In fact, the Release 2 manual states clearly that when you are in Edit mode, the Up or Down Arrow keys enter the formula you were editing and move the cursor to the next cell, just as they do when you enter a brand new formula. Most of the time, that's true. Up or Down Arrow keys switch you from Edit to Point mode only when you edit a formula so that it ends with an arithmetic character, as Mr Predmore explains. And you don't need to delete anything. If you hit F2 and just add a + sign to the end of a formula, the Up and Down Arrow keys do their magic. Add a + sign to the middle of the formula, and the Arrow keys won't put you in Point; they'll behave just as the manual says they will — JT.



You can use ResEdit to change the scroll bar pattern. The pattern to edit is a PAT resource in the System File with an IQ of 17

Bar patterns

You can customise the patterns of your Macintosh scroll bars using Res-Edit. Open your System file and open the PAT resources. Double click on the light grey pattern and make sure that the name of the opened window reads 'Pattern ID = 17'. If it doesn't, immediately close the window. You are now presented with a FatBits-like environment to edit the pattern.

When you are happy with your new pattern, save the System file, quit, reboot and check out your new scroll bars.

Chris Calabrese

Function keys in dBASE

Though this is undocumented, dBASE III lets you set the function keys to issue control characters as well as text strings. SET FUNC 2 TO CHR(23) reprograms the F2 key to send a Ctrl-W (for exiting from a series of GETs or a full-screen EDIT). Further, when BROWsing a wide database, it's convenient to pan right and left with SET FUNC 7 TO CHR(26) and SET FUNC 8 TO CHR(2). Just use the values in the dBASE manual under the INKEY() function for the CHR() numbers.

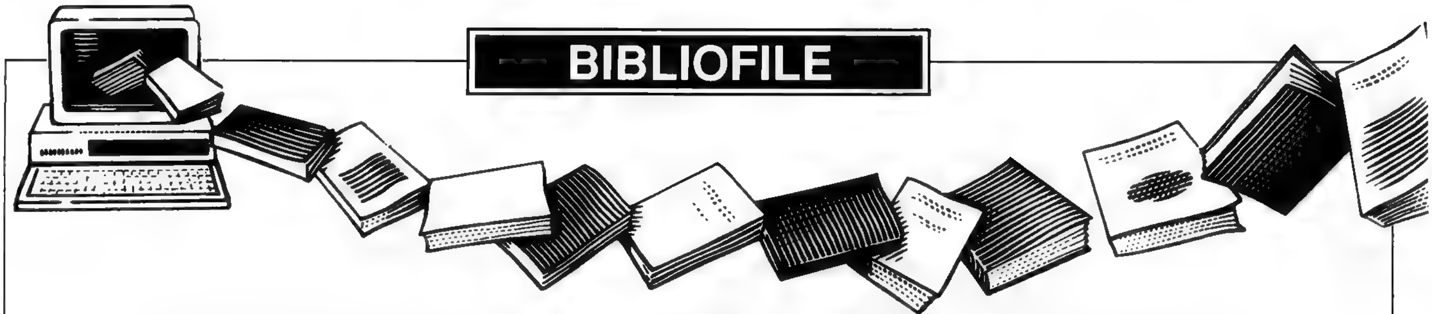
Paul McNamara

Most users have long since customised their CONFIG.DB program to set up their function keys automatically. A second setup for BROWsing and EDITing would also be handy.

Hitting F2 is certainly easier than a Ctrl-W or Ctrl-End, and some computerphobes are strangely terrified by the thought of two-finger key combinations.

You can also issue multiple control codes. For example, SET FUNC 8 TO CHR(2)+CHR(2)+CHR(2) will pan right three times in BROWSE. Note that in BROWSE (only), dBASE takes over the F10 key (it issues a Ctrl-Home to call the special menu). The F1 key is normally unavailable as well — Brad Stark.

END



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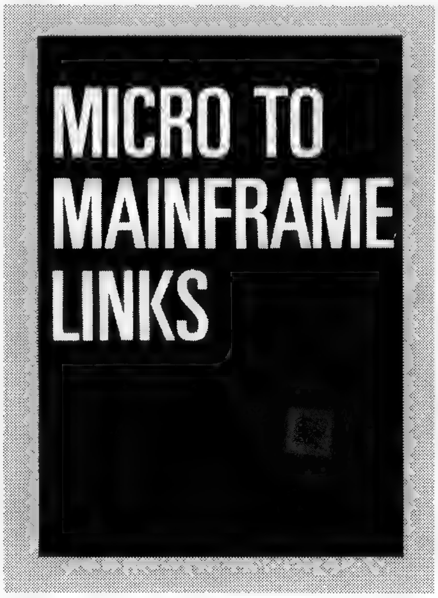
Micro to mainframe links and programming come under scrutiny this month plus a guided tour of IBM.



Micro to mainframe links

Author: Ronald F Kopeck
Publisher: Osborne McGraw-Hill
Price: $39.95

What would you do if you were told that you were solely responsible for connecting your company's standalone personal computer(s) to the mainframe 300 miles away? Go out and buy a long piece of string and two tins? Feign earache for six months? Leave? Well, the first thing you should do is grab hold of a copy of *Micro to Mainframe Links* and read it; it will drive away your (possible) doom and despondency and replace it with knowledge and enthusiasm.

It is at long last appreciated that users want access to systems and files that previously only heavy rimmed be-spectacled, baggy corduroyed-trousered programmers, or your organised and secretive ASIO team, could access and write applications for.

Ronald F Kopeck presents an honest and open approach to all the intricate problems and decisions of linking and/or networking personal computers into host mainframes. Modems and multiplexers, hardware cards, software-only link products, LANs, file servers, data PBXs, integrated voice/data PBXs, and so on, are all brought out into the light and discussed in layman's terms. This book is *not* aimed at the powerful, experienced software engineer but geared towards *'anyone who is trying to get perspective on the whole issue of linking personal computers into hosts.'* Having said that, it is not a woolly 'we-don't-discuss-that-here' type of book either, as the author's scope ranges from 'The Evolution of End-User Environments' to 'Evaluating Prototype Link Results' and 'Establishing a Pilot'.

Micro to Mainframe Links is very informative and can be read from cover to cover or dipped into for specific chapters. Summaries are provided at the end of every chapter for easy consolidation of facts. My only criticism is that the appendices of 'Link Vendors' and 'LAN Vendors' did not contain any Australian suppliers.

Having read this book I now feel that I can look my IRMA board straight in the eye with a smug smile hovering about my lips.

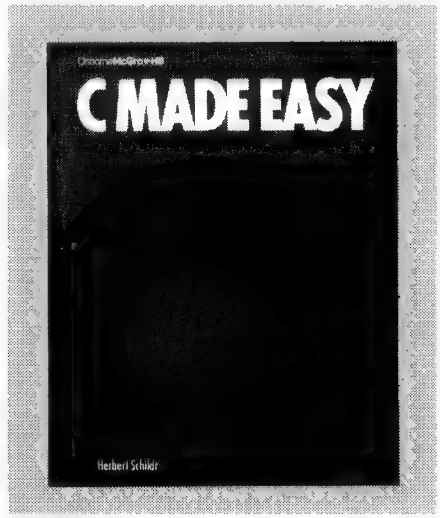
Lorna Kyle

C made easy

Author: Herbert Schildt
Publisher: Osborne McGraw-Hill
Price: $39.95

It's always a good idea to have a new concept explained in terms of a familiar and well-used one: that is, files represented as filing cabinets, records as sheets of paper in the filing cabinet drawers, and so on. This also goes for learning a new programming language, in this case C; compare it with a more familiar one, in this case Basic. That is, of course, if Basic is an old friend; if it isn't, then the comparison to it might be more of an obstacle than encouragement. There again, C probably wouldn't be the first choice for a novice programmer: *'C is a middle-level language because it combines elements of a high-level language with the functionalism of assembler.'*

I'm currently learning C for a project that I'm working on and I did genuinely find this book very helpful. Lots of ex-



amples are given and the author, Herbert Schildt, has a very informal and practical approach throughout: *'When you write programs, remember that someone has to use them (this includes you).'*

There are 11 chapters in all, beginning with a general overview of C and moving through variables and expressions, program control statements, 'building-block' functions, pointers and arrays, and finishing with common programming errors and appendices on statement and library function summaries. Chapter 10 is entirely devoted to 'Writing a C program'. Ideas, functions and structures mentioned in earlier general chapters are expanded upon later on, and chapters 7 and 8 on 'Pointers' and 'Arrays' respectively are worth studying until you have grasped them, as these are very important concepts in the C language: there are no parallel comparisons to Basic here as the languages are dissimilar at this stage.

Useful exercises — with answers — are given at the end of every chapter — although the less honest individuals among us might have been prevented from cheating had the answers been placed at the back of the book.

Lorna Kyle

8086-8088 architecture and programming

Author: JM Trio
Publisher: Macmillan
Price: $30 (subject to change)

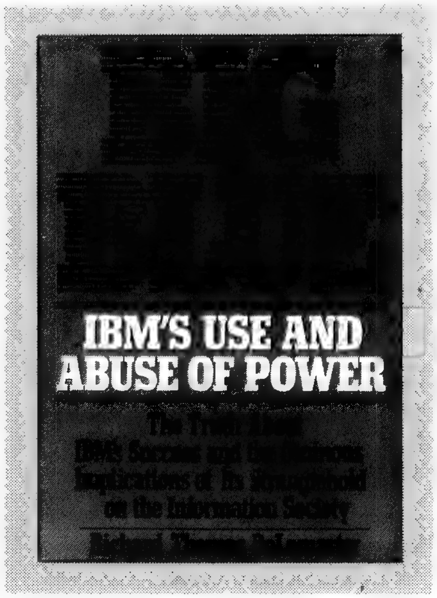
This book has a twofold aim: first, the author sets out to describe the operation of the 16-bit Intel 8086/8088 microprocessors and their associated devices: second, and to my mind the more important, to describe how these microprocessors are programmed in assembly language.

By sticking strictly to the generic instruction set of the processor and making no reference to any specific machine, the book falls into the same trap as many assembly-level tutorials. The extensive example programs throughout are all extremely dull because the author couldn't make any assumptions about the machine being used. Surely with the dominance of the IBM PC and its clones, it would have made more sense to use that machine to give the program examples a bit of meaning.

In the preface Trio states: *'What software designer has not had to concern himself with the programming of a peripheral circuit controlling a dialogue protocol between his machine and its environment, or with a circuit controlling his system interrupts?'* I used to consider myself quite a knowledgeable software designer, but I'm obviously not in Trio's league.

To be fair, the hardware aspects of the 8086/8088 are covered comprehensively and it might make a good substitute for the official Intel technical reference material. But as an introductory book for an 8086 assembly-level programmer however, I'd be impressed if you got past page ten.

Graham Wood



Big Blue — IBM's use and abuse of power

Author: Richard Thomas DeLamarter
Publisher: Macmillan
Price: $35 (subject to change)

The old saying 'No-one ever lost their job buying from IBM' epitomises in many people's minds IBM's powerful and respected image in the computer market-place. The title of this book, therefore, comes as something of an unnerving revelation that all is not what it seems.

The author, Richard DeLamarter, has left no stone unturned in his efforts to reveal the true story behind IBM. Having spent some eight years working as a senior economist for the US Justice Department on the antitrust case 'US vs IBM' before IBM was given a clean bill of health in 1982, and a further four years researching the material for this book, Mr DeLamarter is out to destroy IBM's all-caring, altruistic image, which he feels (and perhaps rightly) is attributable to the antitrust suspicion that the company has engendered over the past 50 years, *forcing* it to lay down a *Business Conduct Policy* for its employees.

He presents a damning indictment (backed up by voluminous detail) of a ruthless company's unrelenting pursuit of 'market share', and how it has used and manipulated its power to gain control.

Divided into four self-contained parts comprising several hundred pages, Big Blue documents the history of IBM, its rise to power and eradication of the competition, its discriminatory pricing strategy and monopolisation of the market, and the ominous implications for the future of IBM's vice-like grip on the computer industry: *'IBM's expanding monopoly over information technology is fast giving it the power to enter and ultimately dominate the many service industries of the future . . .'*

It's chilling, but gripping, stuff, and it's clear that DeLamarter has done his homework as he reels off facts, figures and percentages (tables and appendices abound) to corroborate his story. Without doubt *Big Blue* is an insightful book, while at the same time a totally absorbing read in its own right.

Joanna Murchison

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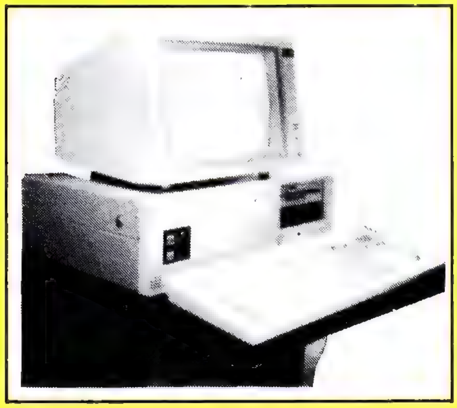

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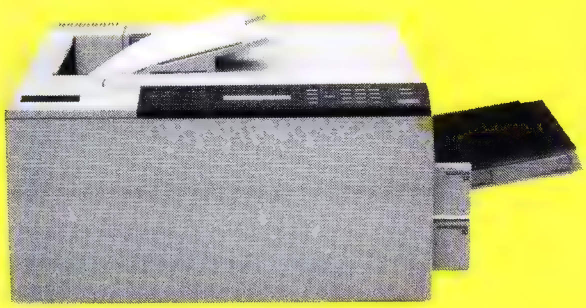

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NUMBERS COUNT

Mike Mudge sets two different problems this month and asks readers to let him know which they prefer.

This month's 'Numbers Count' displays two totally different types of problem in empirical number theory. Readers are, as usual, invited to submit attempts at solution to either (or both) of the problems posed; but are also invited to indicate which subject area they prefer, hopefully with some logical reasoning.

Problem I

The Left Factorial Function

Recall that factorial n, where n is a positive integer, is defined by: $n! = 1.2.3.4.5.6. \ldots n$ thus $6! = 720$, $10! = 3628800$.

Further, $0! = 1$ by definition.

Following D Kurepa we write the left factorial function thus:

$!n = 0! + 1! + 2! + 3! + \ldots + (n-1)!$

thus: $!6 = 0! + 1! + 2! + 3! + 4! + 5!$

hence: $!6 = 154$ and $!11 = 4037914$

Is $!n$ ever divisible by n (without remainder) if n is greater than 2? The conjecture is that the highest common factor of $!n$ and $n!$ is 2.

Further following SS Wagstaff we write:

$B_n = !(n+1) - 1$

$B_n = 1! + 2! + 3! + \ldots + n!$

and observe that 3 is a factor of B_n if n is greater than 1, that 9 is a factor of B_n if n is greater than 4 and that 99 is the factor of B_n if n is greater than 9. How does this generalise?

Problem II:

On a Congruence of Mok-Kong Shen

Recall that two integers a and b are said to be congruent modulo a third integer c if and only if a - b is divisible (without remainder) by c; we write $a \equiv b$ (modulo c), for example $98 \equiv 46$ (modulo 13) because $98 - 46 = 52 = 4.13$.

A Rotkiewicz (1984) asked for all solutions of the congruence: $2^{n-2} \equiv 1$ (modulo n). Five solutions are known in the interval 3, 10^6). The smallest is 20737 and the largest is 540857. What are the others?

Mok-Kong Shen (1986) has shown that there are infinitely many positive integers k such that the congruence $2^{n-k} \equiv 1$ (modulo n) has infinitely many solutions for n; however, it remains an open question whether there are infinitely many solutions for n for *all* positive integers k.

While realising that a computer can never find an infinite number of solutions to any problem, how would the solution to Shen's congruence be efficiently calculated within a given interval for n?

Readers are encouraged to send their thoughts, together with complete or partial attempts at the solutions to either of the above problems, to Mike Mudge, C/- *APC*, 124 Castlereagh Street, Sydney 2000, to arrive by 15 August 1987.

It would be appreciated if such submissions contained a brief summary of results obtained in a form suitable for publication in *APC*. These submissions will be judged using subjective criteria, and a prize will be awarded by *APC* to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a suitable stamped addressed envelope is provided.

Review: January '87

Readers wishing to pursue the connection between The Fermat Quotient and Fermat's Last Theorem are referred to *13 Lectures on Fermat's Last Theorem* by Paulo Ribenboim (Springer-Verlag 1979) while those interested in the computations of Brillhart, Tonascia and Weinberger mentioned in *APC* (January 1987 page 128) should consult *Computers in Number Theory* edited by AOL Atkin and BJ Birch (Academic Press 1971, pages 213/222).

This month's prizewinner is Ray Davies. Ray used Basic and concentrated entirely on the algorithm for solving $a^{p-1} \equiv 1 \pmod{p^2}$ for p prime and different values of a. p is restricted to being less than 2^{15} to avoid integer overflow and the submission contained, in addition to listings and output a significant amount of theoretical background.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or particular, for future Numbers Count articles; all letters will be answered in due course.

LAZING AROUND

Brainteasers courtesy of JJ Clessa.

Quickie

A painter has to paint the numbers on the houses in a street. The houses are numbered 1-100. Which digit does he paint most frequency, and which, less frequently?

Prize puzzle

The five-digit combination number on my safe begins with the digits '79'. The remaining digits are all even.

My home telephone number begins with '90' and ends with '17'. My business telephone number begins with '491' and ends with '4'.

The three missing digits from both telephone numbers are the same as the last three digits of my safe combination.

All three numbers — the safe combination, and the two telephone numbers — have a common factor. What is it, and what are the missing three digits?

Answers on postcards, please, or backs of envelopes only, to reach *APC*, Lazing Around July, 124 Castlereagh Street, Sydney 2000, no later than 30 July 1987.

April prize puzzle

A slightly harder than usual puzzle this time. The problem results in a Diophantine equation which can readily be solved by trial and error methods using a micro.

Although 252, 280, and 288 are all feasible solutions, the answer 288 is the one required, since it is the most satisfactory in terms of the cartesian '. . . There are now getting on for 300 members . . .'

Most entrants gave the correct solution but the winning entry drawn at random came from Mr Greg Bathern of Tuart Hill, WA.

Congratulations, Mr Bathern, your prize is on its way. Keep puzzling.

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

Melbourne	Comnet '87	July 1-2, 1987
Sydney	Contact: Stephen	July 6-7, 1987
Auckland	Moore, Karen Rickwood	July 9-10, 1987
Perth	(02) 439 5133	July 15-16, 1987
Hong Kong	'87 Unix System Software Technology Seminar Contact: AT&T Unix Pacific Co Ltd, No 1 Nan-oh Bldg, 5th Floor 2-21-2, Nishi-Shinbashi Minato-ku, Tokyo 105 Japan (03) 431 3305	July 9-10, 1987
Adelaide	Comtec '87 Contact: Comtec Administration Office, 112 Magill Road Norwood SA 5067 (08) 42 9093	August 3-5, 1987
Sydney	Macworld Expo '87 Contact: Stephen Moore, Karen Rickwood, (02) 439 5133	August 3-5, 1987
Sydney	Comdex '87 TIG Australia Inc. 8 West Street North Sydney NSW 2060 (02) 959 5555	August 19-21, 1987
Melbourne	ACC '87 Contact: Riddell Exhibition Promotions 135-141 Burnley Street Richmond Vic 3121 (03) 429 6088	September 8-10, 1987

USER GROUPS

Below is a list of updates and additions to the full User Groups listing which is available to readers on request. Please send a SSA envelope to 'User Groups', APC, 124 Castlereagh Street, Sydney 2000.

NSW

DTP Graphics SIG (Desktop Publishing) has recently been formed. The group meets on the first Tuesday of each month at Dimension Graphics, 2nd Floor, 201 Miller Street, North Sydney. For more information contact Mark Richards (02) 929 5855

PCWEST is a user group recently formed in Sydney's Western suburbs. Meetings are held on the first Monday of each month at the Function Centre, McDonalds, 15 Ross Street, North Parramatta, at 6pm. Contact Bill McEwen (02) 627 2488 (AH).

Qld

The Bundaberg Commodore Computer User Group (BCCUG) meets on the first Sunday of each month at the Bundaberg West State School library commencing at 10am. For more details contact Jan Kretschmer on (071) 72 7098 or Marion Cheshire on (071) 72 7794.

WA

A Macintosh Club has recently been formed which caters for Macintosh enthusiasts Australia wide. For more details send a SAE to the Software Club, c/- Montrose Publishing, PO Box 25, Tincurrin, WA 6361.

Tas

The Tasmanian TI User Group is officially defunct as of July 1, 1987. Any correspondence connected to this group may still be forwarded to 1 Benboyd Court, Rokeby, Tasmania 7019.

END

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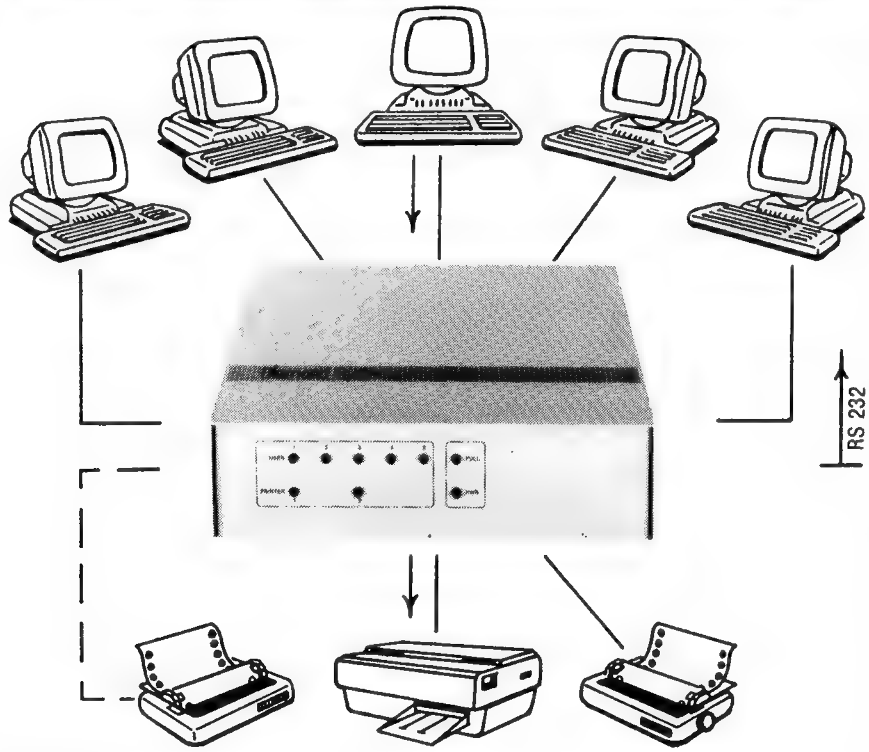

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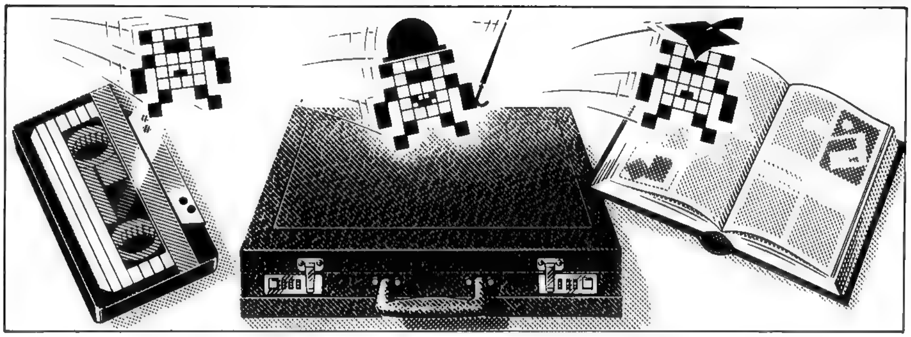

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The missing link

Significant advantages in speed of searching can be gained from this month's programming technique; and Owen Linderholm and associates select the best of readers' program.

This month's programming technique comes courtesy of David Weatherall, in response to the first technique on linked lists (APC April). It describes a method of implementing and accessing a binary tree storage structure. Although this technique requires careful programming and thought, it has significant advantages in speed of searching.

There is a particular form of linking that can make quicker extraction possible, while still retaining the other benefits of linked lists. This method is called the binary tree, or B-tree. An example of a B-tree is shown in the box alongside. The order of entry of the data items already in the tree is shown at the top, with their resulting positions in the tree. Below that are examples of the states of the various pointers involved.

Each data item sits at a node in the tree, and has three pointers associated with it. They point to the parent item and the two daughter items. The first item to be entered is placed at the root node, which is at the top of the tree diagram. Thereafter, each item entered is placed at the end of a new branch according to the following rules:

Compare the input data item with the data item in the B-tree. If the input item is earlier in sequence than the B-tree item being examined, follow the branch to the left; otherwise follow the other branch. Keep doing this comparison with all the B-tree items encountered until you end up trying to go down a branch that doesn't exist. Then hang the input data item on a new branch there.

An example will make the method clearer. Suppose the next data item to be put into the tree is D. On comparing it with the root node item, H, it is clear that D comes before H, so we go down the left-hand chain to E. D also comes before E, so again we take the left-hand branch and arrive at A. As D comes later than A, we should take the right-hand branch. In this case there is no right-hand branch, so we make one and put the new data item, D, at the end of it.

The second table shows how the various pointers appear after the addition of D.

It is a simple matter to extract the desired item again. All that is needed is to use the same rules to journey through the tree, and end the search

APC is interested in programs written in any of the major programming languages for all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper — typed if you have no printer. Please ensure that the software itself, the documentation and the listing are all marked with your name, address, program title, machine (along with any minimum requirements) and — if possible — a daytime phone number.

Check through the previous Program Files to see the kind of programs we prefer. As a rough guide, original ideas are always welcome, as are good implementations of utilities and applications. Obviously the programs should be well-written, easy to understand, and preferably not too long (remember that other readers have to type them in). All programs should be fully debugged and your own original, unpublished work. We prefer to receive programs with a maximum 80-column width printed in emphasised typeface. If possible, please include printed sample output.

We will try to return submissions if they are accompanied by a stamped, addressed envelope of the appropriate size, but please keep a copy of everything. Programs are paid for at the rate of $50 per page of published listing.

Send your contributions to Program File, *APC*, 77 Glenhuntly Road, Elwood 3184.

once the desired item has been reached.

The example program shown demonstrates the various functions in Microsoft Basic. The main program is in the lines 10-240, the subroutine for putting data into the B-tree is in lines 60000-60210, and the extraction subroutine is in lines 60500-60570.

Speed

How quickly can data be extracted from a B-tree? Suppose we have a balanced B-tree containing 32,000 data items. The first decision eliminates 16,000 items from the search immediately, the next rejects 8000, and so on. Only 16 data items need to be examined in order to extract the desired one. You can see that this method is very useful for large files, as doubling the file size to 64,000 items would only increase the number of items to examine by one.

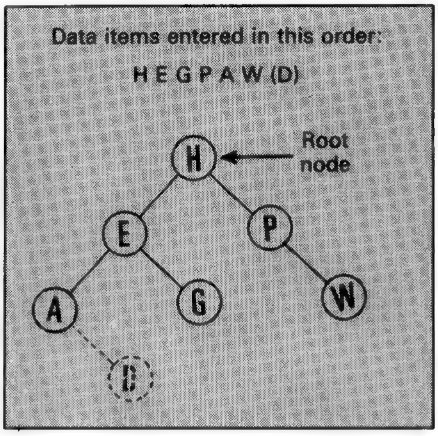
However, the data must be entered in unsorted order. If the data were entered in sorted order, all we would have would be a linked list, and retrieval would be much slower.

It might be thought that randomly entered data would result in slow retrieval times when compared with a balanced tree where each node had exactly two data items hanging from it. In fact, the randomly entered tree is only about 38 per cent slower than the perfectly balanced tree in searching — which, in most cases, is not enough to warrant trying to improve it.

This is all very well, but we still haven't extracted the items of data in sorted order.

Sorting

The logic behind this is more complex than straightforward data entry and retrieval. The algorithm itself appears



Arrays before addition of D

	Data items D$(N)	Left chain BT%(0,N)	Right chain BT%(1,N)	Upwards chain BT%(2,N)
1	H	2	4	0
2	E	5	3	1
3	G	0	0	2
4	P	0	6	1
5	A	0	0	2
6	W	0	0	4
7				

Arrays after addition of D

	Data items D$(N)	Left chain BT%(0,N)	Right chain BT%(1,N)	Upwards chain BT%(2,N)
1	H	2	4	0
2	E	5	3	1
3	G	0	0	2
4	P	0	6	1
5	A	0	7	2
6	W	0	0	4
7	D	0	0	5

in lines 60700-60820 of the example program, and the following is a description of how it works.

Take a look at the B-tree diagram. The early items in sorted sequence are always to the left of the later ones, and the first item is the left-most one. So, as a general rule for extracting items in sorted order, we should keep going to the left as much as possible and only go to the next piece of the tree when all the nodes in the current part of the tree have been accessed.

To start, place yourself at the root node.

- **Step 1** Go down the tree, taking the left-pointing branch at each node until you can't go any further. Use that one and make a note that you have used it.
- **Step 2** The current node is on the path towards the next one in the sorted sequence, so go to the daughter node on the right (if it exists). Do not use it, but return to Step 1.
- **Step 3** If there is no daughter node to the right, go back up the tree, looking for the first unused node. Once found, use it, make a note to that effect and go to Step 2.

Of course, there will be a stage when all the nodes have been retrieved and returning up the tree will eventually bring you to the root node, which itself will have been used. When that condition has been detected, the sorted list is finished.

Summary

Normally, sorting is needed because data is held on the disk (or in memory) in the order it has been entered, and it needs to be output in sorted order. All that is needed to avoid the sorting stage is a small routine to add chain information to data records at entry time. Thereafter the data items are available in the order of entry, sorted order, or individually by key, without any further work.

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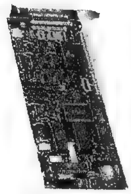

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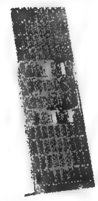

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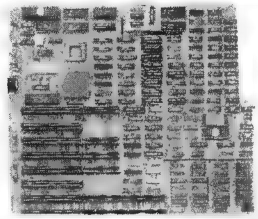

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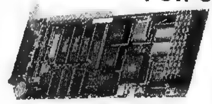

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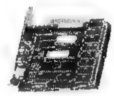

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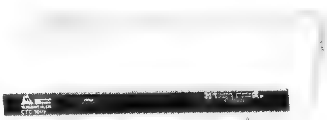

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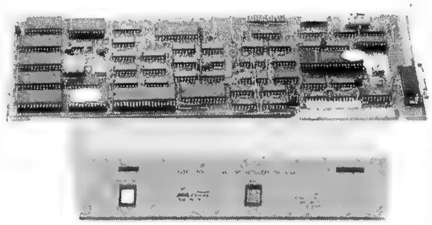

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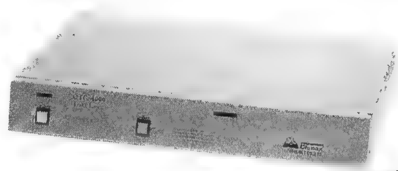

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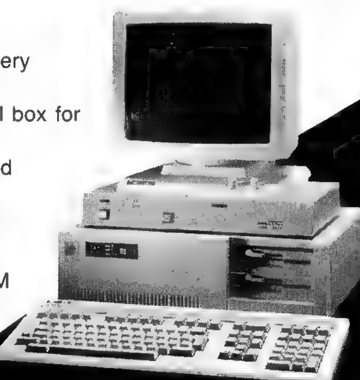

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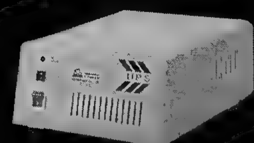

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```
10 PRINT "BINARY TREE DEMONSTRATION PROGRAM":PRINT:PRINT
20 PRINT "This program generates random strings"
30 PRINT "and puts the unique ones into a binary tree."
40 PRINT:PRINT "Then they are listed in sorted order, and"
50 PRINT "finally you may extract any of them by request."
60 PRINT:INPUT "How many items would you like";N
70 IF N<1 THEN END
80 GOSUB 60900:NX%=1:REM dimension arrays


90 REM now to generate random strings
100 REM and put them into the btree
110 FOR I=1 TO N:X$=""
120 FOR J=1 TO 6:X$=X$+CHR$(65+INT(RND(4)*26)):NEXT J
130 GOSUB 60000:PRINT X$,"Item number";I:NEXT I


140 PRINT:PRINT "The B-tree is now filled."
150 PRINT "Press the <RETURN> key to list it in sorted order."
160 WHILE INKEY$<>CHR$(13):WEND
170 AP%=1
180 GOSUB 60700:IF ET=0 THEN PRINT D$(AP%),"Item number";AP%:GOTO 180


190 PRINT:PRINT:PRINT"All items now output."
200 PRINT:PRINT"You may now extract any item."
210 PRINT"Just enter the string you desire."
220 INPUT"Your string";X$:IF X$="" THEN END
230 GOSUB 60500:IF ET=1 THEN PRINT"No such item.":GOTO 220
240 PRINT D$(AP%),"Item number";AP%:GOTO 220


60000 REM put data in btree array d$(n)
60010 REM bt% array holds btree pointers
60020 REM bt%(0,n) is left chain pointer
60030 REM bt%(1,n) is right chain pointer
60040 REM bt%(2,n) is chain pointer to mother node (upwards)
60050 REM lr% is left/right indicator (0=left, 1=right)
60060 REM ap% is array pointer for moving through btree
60070 REM nx% is pointer to next vacant spot in array
60080 REM x$ is input data to be put into btree
60090 REM first search btree for end of chain
60100 LR%=0:AP%=1
60110 IF X$<D$(AP%) THEN LR%=0 ELSE LR%=1
60120 IF BT%(LR%,AP%)<>0 THEN AP%=BT%(LR%,AP%):GOTO 60110
60130 REM end of chain has been reached.
60140 REM now to add input data (x$) to btree
60150 REM first adjust pointer to point to new item
60160 BT%(LR%,AP%)=NX%
60170 REM now add new item complete with pointers
60180 D$(NX%)=X$
60190 BT%(2,NX%)=AP%:REM upwards pointer
60200 BT%(0,NX%)=0:BT%(1,NX%)=0:NX%=NX%+1
60210 RETURN


60500 REM extract specified item from btree
60510 REM search key is x$
60520 REM success shows et=0, failure shows et-1
60530 AP%=1:ET=0
60540 IF X$=D$(AP%) THEN RETURN
60550 IF X$<D$(AP%) THEN LR%=0 ELSE LR%-1
60560 IF BT%(LR%,AP%)<>0 THEN AP%-BT%(LR%,AP%):GOTO 60540
60570 ET 1:RETURN

60700 REM output items from btree array in sorted order
60710 REM start with ap%=1 before calling subroutine
60720 REM return with et=0 and pointer to d$() in ap%
60730 REM if et=1 then end of list has been reached
60740 REM got%() is array for noting items used
60750 ET=0:IF GOT%(AP%)<>0 THEN GOTO 60780
60760 IF BT%(0,AP%)<>0 THEN AP%=BT%(0,AP%):GOTO 60760
60770 IF GOT%(AP%)<>1 THEN GOT%(AP%)=1:RETURN
60780 IF BT%(1,AP%)<>0 THEN AP%=BT%(1,AP%):GOTO 60760
60790 IF AP%=1 AND GOT%(1)=1 THEN ET=1:RETURN
60800 AP%=BT%(2,AP%):REM go up to mother node
60810 IF GOT%(AP%)=1 THEN GOTO 60790
60820 GOT%(AP%)=1:RETURN
60900 REM dimension  btree arrays ready for work
60910 REM if listing in sorted order not required,
60920 REM there is no need for got%(n)
60930 DIM D$(N):DIM BT%(2,N):DIM GOT%(N)
60940 RETURN
```

Program of the Month
BBC/QL Solitaire

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *6663 #

by Cliff Hatch and Phil Willcox

This month's programs

The Program of the Month is Solitaire by Cliff Hatch and Phil Willcox. It illustrates some intelligent games programming techniques and is presented superbly. If anyone wants to know how I would like to receive programs — *this* is how!

Other programs this month include a program for the IBM/compatibles to provide a link from Basic to MS-DOS; a program for the Amstrad CPC series to automatically switch off the screen if the computer is unused for a certain amount of time; a program for the Amstrad PCW range to provide an address database and mailmerge facility for Locoscript; and a listing in Microsoft's Excel macro language to accompany Jack Weber's article on rule induction in this issue.

This program plays the board game Solitaire. It is designed to give an insight into the 'mechanics' of gameplaying programs, particularly the use of recursion and strategy. It is written in BBC Basic and is first presented using a recursive brute force method to solve the game; strategy is added later so that its effect on performance can be seen. The BBC micro enhances the demonstration of the techniques used, by the use of colour graphics.

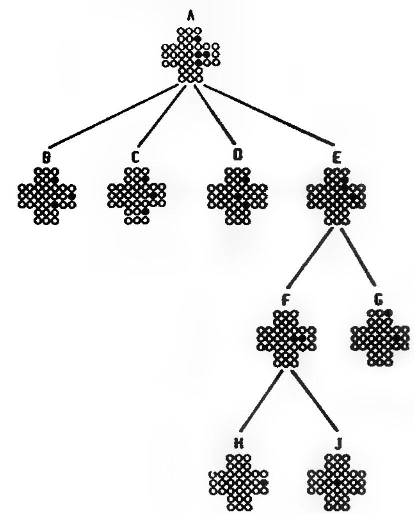

Fig 1 Simplified game tree

The game of Solitaire

Solitaire is a one-player game. The board has 33 holes into which 32 pins are inserted. The object of the game is to move the pins, which can take each other in a similar way to draughts, and to end up with one pin in the centre of the board. Pins can move vertically and horizontally — not diagonally. The rules are simple, but Solitaire is a difficult game because there are millions of combinations of moves to choose from.

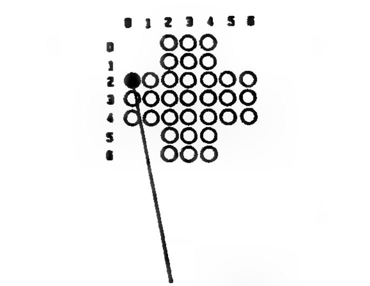

Fig 2 Coordinate system

Why recursion?

Fig 1 shows that the game can be visualised as a 'tree of board positions'. I have simplified the example by choosing the starting position, 'A', with only four pins on the board. The tree was constructed by considering all possible moves from 'A'. One particular set of moves leads to 'J', which is the solution. You could solve the game of Solitaire from any starting position by drawing a tree like this and then looking along the ends of the branches for the solution. By working back up the tree you could easily deduce the moves which led to the solution. If the number of pins on the board at the start is large (as in Fig 1) then it becomes an impossible task to do this on paper, but the principle remains the same. If you visualise the game as a tree, then you can solve it by searching the tree!

Tree searching is a naturally recursive activity. In 'The missing link' (*APC* December 1986), Mike James explained the reason for this with reference to binary trees. The concept applies equally well to game trees.

Computer representation

In the Basic programs I represent the Solitaire board by a two-dimensional integer array, a%(,), with subscripts matching the coordinates shown in Fig 2. Each element of the array holds a '1' to indicate that a pin is present, a '0' to indicate no pin present, or a '9' to indicate out of bounds. A stack of Solitaire boards is created by using the three-dimensional a%(,,) instead of a%(,). The directions of movement — north, east, south and west — are represented by the integers 1, 2, 3 and 4.

We also need a notation for printing out the solution. Suppose that the eleventh move involves moving the pin at coordinates 0,3 eastwards; we would print this '11:0,3>E'. For readability, the directions 1, 2, 3 and 4, used inside the program, are translated to N, S, E and W for printing out the solution. So, for example, the program would print the solution to position 'A' in Fig 1 as '3:5,3>W 2:4,1>S 1:4,4>N'. The moves are printed in reverse order for reasons which will become clear later.

The programs

Before delving into the Basic code, it is useful to consider the underlying structure. 'Solit' is the recursive procedure which forms the heart of the program: its job is to identify and execute legal moves. It considers one hole and one direction of movement at a time, so it has to be called many times to check for legal moves over the whole board. Each time a legal move is found, Solit executes it — generating a new board position — then calls itself to check for legal moves in the new position, and so on. It looks out for the solution as it goes. On each call Solit needs to know the current state of the board, and which move to consider.

In Basic the parameters 'state', 'move', and so on, are comprised of more than one variable. Loop statements like 'for all move' generate the parameter 'move' for each call of Solit. Loops like this translate to three nested loops in Basic (lines 290 to 360 and 730 to 880). Since the board is represented by a 7x7 array and there are four directions of movement, Solit is called 7x7x4=196 times to cover the whole board. It checks the legality of each move in lines 420 to 540. If the move is illegal then it returns without taking any action; otherwise it executes the move, resulting in the generation of a new board state (lines 640 to 660), then it calls itself to examine all possible moves in the new board state (lines 730 to 880). When the solution is found, Solit sets the globe flag sol% (line 710). It then unwinds, printing out the moves which led to the solution as it goes.

The unwinding process naturally prints the moves in reverse order because Solit returns from the solution back to the starting position. If the program is given a starting position for which there is no solution, it searches the entire tree before printing conclusively 'no solution exists'.

When the solution has been found and printed out, the program stops. It does not continue to search the rest of the tree for possible alternative solutions.

The game's starting position is defined in data statements (lines 900 to 980). The first two numbers are the maximum x and y coordinates (that is, the size of the board). These are followed by the layout of the pins (1 for a pin, 0 for no pin, and 9 for an out of bounds hole); the last two numbers are the coordinates of the 'win' hole, where the last pin has to end up. By altering these data statements you can set up any starting position you like, and you can even experiment with different sized and shaped boards (bear in mind that the graphics routines will not cope with oversized boards).

Quirks

- The level to which FOR NEXT loops can be nested is limited to ten in BBC Basic — hence the untidy looking GOTO loops in lines 730 to 880.
- Since the passing of arrays to procedures as parameters is not implemented in BBC Basic, it not possible to pass board positions to Solit using the two-dimensional array a%(,). To get round this problem an extra dimension is added to the array, making it a%(,,). This allows it to hold a stack of board positions with third dimension representing the 'height' of the stack. The local parameter dep% (depth of call) is used as a pointer to determine which level of the stack to access. On each recursive call Solit works at the appropriate level of the stack, so board positions established by previous calls remain undisturbed.

Running the programs

The program first initialises four windows on the screen. The top two display the starting position and the position currently being searched; the middle window displays a static 'Solitaire' banner; the bottom window displays messages indicating how may positions have been examined, how many pins are currently remaining, and the depth of recursive calls — it also displays the solution when it is found. You might like to try running the program with different starting positions by modifying the data statements in lines 910 to 970.

To get an initial feel for the way the program works it is best to stick to simple problems, with five pins, say. The easiest way to invent solvable problems is to get hold of a Solitaire set and play a few moves backwards from the solution. Watch the program play and see if you can recognise the order in which it examines the moves — the order is specified by the three nested loops (lines 730 to 880). If it arrives at a state where it can find no further moves, it backtracks through previous board positions until it finds one. The program solves problems with five pins in minutes. If you try some starting positions with six, seven and eight pins, and so on, you will probably find that the time increases dramatically.

Recursion and brute force

Try setting up the full starting position. Run the program and watch it play for

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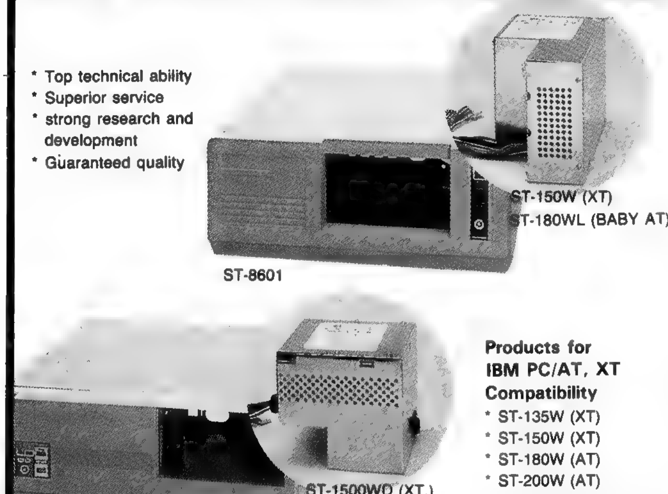

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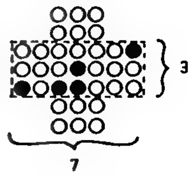
a while. At first things seem to go quite well. The program quickly succeeds in removing most of the pins from the board — but then, a serious flaw in its style of play emerges. It spends an enormous amount of time examining positions which cannot possibly lead to the solution, usually because one or more pins have become stranded at the edge of the board. Positions like these are obviously hopeless to the human eye, but the machine blindly continues to explore them. You might begin to suspect that it would take months, perhaps years, to solve the game.

The problem is that the tree is too large to search by brute force. It contains millions of board positions. It would help if we could somehow cut the tree down to a more manageable size — which brings us to strategy.

Recursion and strategy

One way of speeding up the search would be to cut some branches off the tree — preferably without cutting off the solution(s). A possible strategy would be to check every board position during the search and judge whether or not it might lead to the solution. If, for example, the position contains a pin stranded at the edge of the board, then it obviously won't lead to the solution — in which case there is no need to search any deeper from that position. That particular branch can be cut off.

Additions to the programs to demonstrate this strategy are shown in Listing 2. Type the appropriate version on top of Listing 1. The resulting program uses a function called 'treesaw' to judge whether or not the current position is worth searching. It returns a '0' if it is not worth searching and a '1' if it is. Treesaw is called after every move (line 713). If the current position is not worth searching, then Solit cuts off the the branch by simply executing a RETURN (line 716). No further recursive calls are made from that position.



Sum of Sides = 3 + 7 = 10
Number of pins = 5
limit%(5) = 9

In this case the Sum of the Sides is greater than the limit set for 5 pins - so treesaw would cut the branch at this point. The possible moves remaining would not be explored.

Fig 3 Treesaw algorithm

Treesaw uses a simple scoring function. All board positions score either 0 or 1. The function works by measuring how dispersed the pins are — Fig 3 shows an example. An imaginary rectangle is drawn on the board enclosing all the pins. The lengths of the sides of the rectangle are then added together and the result is compared with a predetermined limit. If it is greater than the limit, the pins are considered to be too dispersed to lead to a solution: the word 'reject' is printed in the text window and treesaw returns a 0 (lines 2150 to 2180).

The limit on the size of the rectangle is related to the number of pins on the board — more pins can reasonably occupy more space. It is obtained from the array limit%( ) with the subscript denoting the number of pins on the board. Only positions containing from 2 to 12 pins are examined; all those with more than 12 pins are assumed to be worth searching further.

The values in limit%() are loaded from a data statement in line 2190. These values were obtained by experimentation, working backwards from the solution and observing the size of the rectangles generated. We have no theoretical argument to support their correctness — they just seem to fit. If they are not correct, treesaw might make inaccurate judgments and cut off branches which contain the solution. We have acknowledged this possibility by changing line 370 to print 'NO SOLUTION FOUND' instead of 'NO SOLUTION EXISTS'.

The treesaw function demonstrates how strategy can be applied 'on top of' the recursive search. It significantly improves the performance of the program. Despite the fact that the scoring function is based on one simple rule, it generally manages to cut down the size of the search by more than 50 per cent.

The program is deliberately simple in order to provide an effective demonstration of the techniques used. Also, the simplicity of the treesaw function makes it a useful starting point for experimenting with different strategies.

Conclusion

The program shows how a recursive tree search can be used to solve the board game Solitaire, and how performance can be improved by the addition of strategy. The program is designed to give a simple demonstration of game-playing techniques, and to provide a starting point for experimenting with new ideas.

The concepts of recursion and strategy also apply to two-player games like draughts and chess, although these are much more complex and challenging. Their implementation requires faster computation and more intricate strategy than is appropriate for Solitaire.

Listing 1

```
10 REM BBC solitaire
20 REM phil willcox, nov 86
30 REM adapted from QL program by Cliff Hatch
40 REM ****************************************
50 MODE7:DIM dir$(4):dir$(1)="N":dir$(2)="E":dir$(3)="S":dir$(4)="W"
60 PROCgraphinit
70 REM read the initial board configuration and count the pins
80 READ dx%,dy%
90 DIM a%(dx%,dy%,50)
100 np%=0
110 FOR y%=0 TO dy%
120   FOR x%=0 TO dx%
130     READ a%(x%,y%,0)
140     IF a%(x%,y%,0)=1 THEN np%=np%+1
150     NEXT
160   NEXT
170 READ wx%,wy%
180 REM
190 sol%=0:m%=0:dep%=0:pr%=0:vpos%=0
200 lx%=9-INT(dx%/2):IF lx%(5 THEN lx%=5
210 rx%=lx%+dx%+2:IF rx%)17 THEN rx%=17
220 ty%=6-INT(dy%/2):IF ty%(2 THEN ty%=2
230 by%=ty%+dy%+2:IF by%)10 THEN by%=10
240 PROCboardplot(lx%,by%,rx%,ty%)
250 lx%=lx%+19:IF lx%(22 THEN lx%=22
260 rx%=lx%+dx%+2:IF rx%)34 THEN rx%=34
270 PROCboardplot(lx%,by%,rx%,ty%)
280 REM solve
290 FOR y%=0 TO dy%
300   FOR x%=0 TO dx%
310     FOR dir%=1 TO 4
320       PROCsolit(x%,y%,dir%,dep%,np%)
330       IF sol%=1 THEN PRINT" ";dep%+1;":";x%;",";y%;"]";dir$(dir%);:dir%=4:
x%=dx%:y%=dy%
340       NEXT
350     NEXT
360   NEXT
370 IF sol%=0 THEN PRINT"NO SOLUTION EXISTS"
380 END
390 REM
400 DEF PROCsolit(x%,y%,dir%,dep%,np%)
410 LOCAL xx%,yy%,dirc%
420 REM check there is a pin at x%,y% to move
```

```
430 IF a%(x%,y%,dep%)<>1 THEN ENDPROC
440 REM check it is possible to move pin in specified direction
450 IF dir%=1 THEN destx%=x%:desty%=y%-2:skipx%=x%:skipy%=y%-1
460 IF dir%=2 THEN destx%=x%+2:desty%=y%:skipx%=x%+1:skipy%=y%
470 IF dir%=3 THEN destx%=x%:desty%=y%+2:skipx%=x%:skipy%=y%+1
480 IF dir%=4 THEN destx%=x%-2:desty%=y%:skipx%=x%-1:skipy%=y%
490 REM check for destination off board
500 IF destx%<0 OR desty%<0 OR destx%>dx% OR desty%>dy% THEN ENDPROC
510 REM check for destination occupied or illegal
520 IF a%(destx%,desty%,dep%)=1 OR a%(destx%,desty%,dep%)=9 THEN ENDPROC
530 REM check there is a pin to jump over
540 IF a%(skipx%,skipy%,dep%)<>1 THEN ENDPROC
550 REM ok - legal move found
560 REM copy current state of play into next level of array
570 FOR yy%=0 TO dy%
580   FOR xx%=0 TO dx%
590     a%(xx%,yy%,dep%+1)=a%(xx%,yy%,dep%)
600     NEXT
610   NEXT
620 dep%=dep%+1
630 REM
640 REM make the move
650 m%=m%+1
660 a%(x%,y%,dep%)=0:a%(skipx%,skipy%,dep%)=0:a%(destx%,desty%,dep%)=1:np%=np%
-1
670 PROCboardplot(lx%,by%,rx%,ty%)
680 vpos%=vpos%+1:IF vpos%>9 THEN vpos%=9
690 PRINTTAB(0,vpos%)"states ";m%;", pins ";np%", depth ";dep%
700 REM check if this is a solution
710 IF np%=1 AND a%(wx%,wy%,dep%)=1 THEN sol%=1:PRINT"SOLUTION FOUND:":ENDPROC
720 REM explore all possible remaining moves until solution found
730 yy%=-1:xx%=-1:dirc%=0
740 yy%=yy%+1
750   xx%=xx%+1
760     dirc%=dirc%+1
770       PROCsolit(xx%,yy%,dirc%,dep%,np%)
780       IF sol%=0 GOTO 840
790       IF dep%<9 THEN PRINT" ";
800       PRINT;dep%+1;":";xx%;",";yy%;"]";dir$(dirc%);
810       pr%=pr%+1
820       IF pr%=4 THEN PRINT:pr%=0:ELSE PRINT" ";
830       dirc%=4:xx%=dx%:yy%=dy%
840     IF dirc%<4 GOTO 760
850     dirc%=0
860   IF xx%<dx% GOTO 750
870   xx%=-1
880 IF yy%<dy% GOTO 740
890 ENDPROC
900 DATA 6,6
910 DATA 9,9,0,1,0,9,9
920 DATA 9,9,0,1,0,9,9
930 DATA 0,0,1,0,0,0,0
940 DATA 0,1,1,0,0,1,0
950 DATA 0,1,1,1,0,1,0
960 DATA 9,9,0,1,0,9,9
970 DATA 9,9,0,0,0,9,9
980 DATA 3,3
990 REM
1000 DEF PROCgraphinit
1010 REM set up "solving" and "current" boards
1020 PRINTTAB(0,1);CHR$135;CHR$157;CHR$132"   SOLVING:    ";CHR$156;CHR$131;CHR
$157;CHR$132;"CURRENT STATE:  ";CHR$156
1030 FOR y%=2 TO 10
1040   PRINTTAB(0,y%);;CHR$135;CHR$157;CHR$129
1050   PRINTTAB(18,y%);CHR$156;CHR$131;CHR$157;CHR$129
1060   PRINTTAB(38,y%);CHR$156
1070   NEXT
1080 REM set up "solitaire" banner
1090 FOR y%=12 TO 13
1100   PRINTTAB(7,y%);CHR$141;CHR$129;CHR$157;CHR$135:"S O L I T A I R E  ";CHR
$156
1110   NEXT
1120 ENDPROC
1130 REM
1140 DEF PROCboardplot(lx%,by%,rx%,ty%)
1150 LOCAL x%,y%
1160 VDU28,lx%,by%,rx%,ty%
1170 CLS
1180 FOR y%=0 TO dy%
1190   FOR x%=0 TO dx%
1200     IF a%(x%,y%,dep%)=0 THEN PRINT;"o";:ELSE IF a%(x%,y%,dep%)=1 THEN PRIN
T"*";:ELSE PRINT" ";
1210     NEXT
1220   PRINT
1230   NEXT
1240 VDU28,0,24,39,15
1250 ENDPROC
```

Listing 2

```
5 REMark ************************
10 REMark QL solitaire
15 REMark cliff hatch, nov 86
20 REMark ************************
25 CLEAR:CLS:DIM dir$(4):dir$(1)="N":dir$(2)="E":dir$(3)="S":dir$(4)="W"
30 graphinit
35 REMark read the initial board configuration and count the pins
40 READ dx%,dy%
45 DIM a%(dx%,dy%)
50 np%=0
55 FOR yy=0 TO dy%
60   FOR xx=0 TO dx%
65     READ a%(xx,yy)
70     IF a%(xx,yy)=1 THEN np%=np%+1
75   END FOR xx
80 END FOR yy
85 READ wx%,wy%
90 REMark
95 boardplot a%,2:boardplot a%,3
100 REMark solve
105 sol%=0:m%=0:dep%=1:pr%=0
110 FOR yy=0 TO dy%
115   FOR xx=0 TO dx%
120     FOR rdir=1 TO 4
125       solit a%,INT(xx),INT(yy),INT(rdir),(dep%),(np%)
130       IF sol%=1 THEN
135         PRINT " ";dep%;":";xx;",";yy;">";dir$(rdir);
140         EXIT yy
145       END IF
150     END FOR rdir
155   END FOR xx
160 END FOR yy
165 IF sol%=0 THEN PRINT "NO SOLUTION EXISTS"
170 STOP
175 REMark ******************************************
180 DEFine PROCedure solit (a%,x%,y%,dir%,dep%,np%)
185   LOCal ac%(dx%,dy%),xx,yy,rdir,depc%
190   BEEP 250,500
195   REMark check there is a pin at x%,y% to move
200   IF a%(x%,y%)<>1 THEN RETurn
205   REMark check it is possible to move pin in specified direction
210   rdir=dir%
215   SELect ON rdir
220     ON rdir=1
225       destx%=x%:desty%=y%-2:skipx%=x%:skipy%=y%-1
230     ON rdir=2
235       destx%=x%+2:desty%=y%:skipx%=x%+1:skipy%=y%
240     ON rdir=3
245       destx%=x%:desty%=y%+2:skipx%=x%:skipy%=y%+1
250     ON rdir=4
255       destx%=x%-2:desty%=y%:skipx%=x%-1:skipy%=y%
260   END SELect
265   REMark check for destination off board
270   IF destx%<0 OR desty%<0 OR destx%>dx% OR desty%>dy% THEN RETurn
275   REMark check for destination occupied or illegal
280   IF a%(destx%,desty%)=1 OR a%(destx%,desty%)=9 THEN RETurn
285   REMark check there is a pin to jump over
290   IF a%(skipx%,skipy%)<>1 THEN RETurn
295   REMark ok - legal move found
300   REMark copy the current state of play into local variables
305   BEEP 100,0
310   FOR yy=0 TO dy%
315     FOR xx=0 TO dx%
320       ac%(xx,yy)=a%(xx,yy)
325     END FOR xx
330   END FOR yy
335   depc%=dep%+1
340   REMark
345   REMark make the move
350   ac%(x%,y%)=0:ac%(skipx%,skipy%)=0:ac%(destx%,desty%)=1:np%=np%-1
355   m%=m%+1
360   CLS #3:AT #3,0,2:PRINT #3,"CURRENT STATE:"
365   boardplot ac%,3
370   PRINT "states ";m%;", pins ";np%;", depth ";dep%
375   REMark check if this is a solution
380   IF np%=1 AND ac%(wx%,wy%)=1 THEN sol%=1:PRINT "SOLUTION FOUND:":RETurn
385   REMark explore all possible remaining moves until solution found
390   FOR yy=0 TO dy%
395     FOR xx=0 TO dx%
400       FOR rdir=1 TO 4
```

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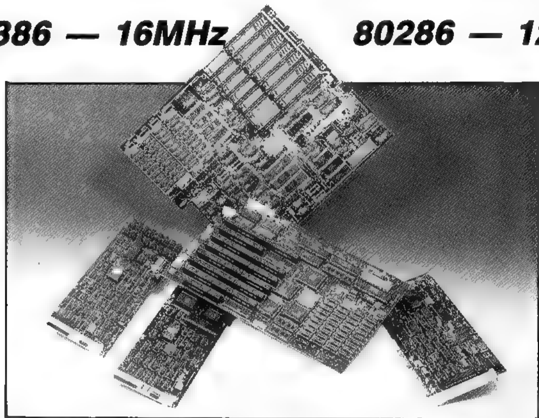

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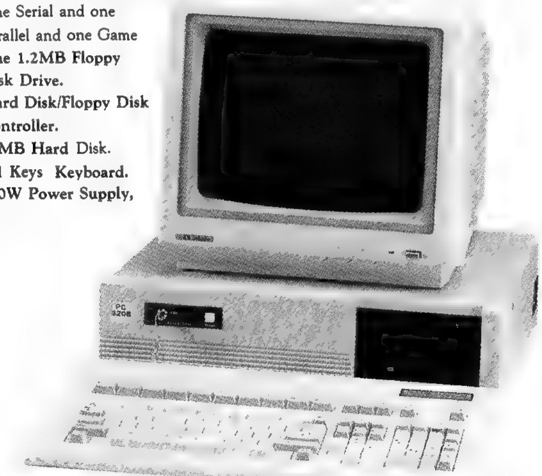

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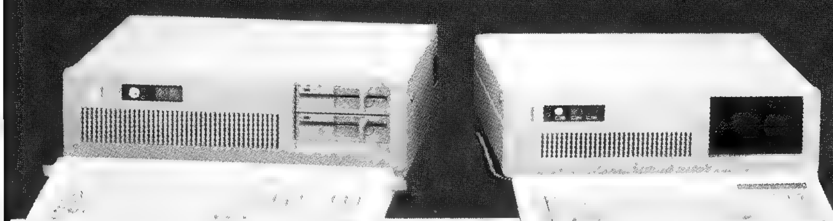

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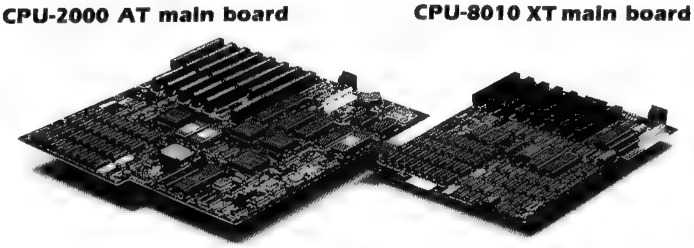

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```
405        solit ac%,INT(xx),INT(yy),INT(rdir),(depc%),(np%)
410        IF sol%=1 THEN
415          IF depc%<10 THEN PRINT " ";
420          PRINT depc%;":";xx;",";yy;")";dir$(rdir);
425          pr%=pr%+1
430          IF pr%=4 THEN PRINT:pr%=0:ELSE PRINT " ";
435          BEEP 100,depc%
440          EXIT yy
445        END IF
450      END FOR rdir
455    END FOR xx
460  END FOR yy
465 END DEFine solit
470 DATA 6,6
475 DATA 9,9,0,1,0,9,9
480 DATA 9,9,0,1,0,9,9
485 DATA 0,0,1,0,0,0,0
490 DATA 0,1,1,0,0,1,0
495 DATA 0,1,1,1,0,1,0
500 DATA 9,9,0,1,0,9,9
505 DATA 9,9,0,0,0,9,9
510 DATA 3,3
515 REMark ********************************************
520 DEFine PROCedure graphinit
525   REMark clear all windows to black
530   MODE 8:PAPER #0,0:CLS #0:PAPER #1,0:CLS #1:PAPER #2,0:CLS #2
535   REMark set up the "solving" window
540   WINDOW #2,215,100,40,9
545   PAPER #2,6:BORDER #2,2,7:INK #2,2:CLS #2:STRIP #2,7
550   AT #2,0,5:PRINT #2,"SOLVING:"
555   REMark set up the "current state" window
560   OPEN #3,scr_215x100a256x9
565   PAPER #3,6:BORDER #3,2,7:INK #3,2:CLS #3:STRIP #3,7
570   AT #3,0,2:PRINT #3,"CURRENT STATE:"
575   REMark set up "solitaire" banner
580   WINDOW #0,431,25,40,110
585   PAPER #0,1:BORDER #0,2,7:INK #0,7:CLS #0
590   CSIZE #0,3,1:AT #0,0,9:PRINT #0,"Solitaire";:CSIZE #0,0,0:CURSOR #0,0,0
595   REMark set up "text" window
600   WINDOW #1,431,120,40,136
605   PAPER #1,2:BORDER #1,2,7:INK #1,7:CLS #1
610 END DEFine graphinit
615 REMark ********************************************
620 DEFine PROCedure boardplot (a%,chano%)
625   LOCal xx,yy,startx%,starty%,pitch%,rad%
630   startx%=40:starty%=85:pitch%=13:rad%=5
635   FOR yy=0 TO dy%
640     FOR xx=0 TO dx%
645       IF a%(xx,yy)=0 THEN FILL #chano%,0:ELSE FILL #chano%,1
650       IF a%(xx,yy)<>9 THEN CIRCLE #chano%,startx%+xx*pitch%,starty%-yy*
pitch%,rad%
655     NEXT xx
660   NEXT yy
665 END DEFine boardplot
```

Listing 3 BBC treesaw procedure

```
 175 DIM limit%(12):FOR j%=2 TO 12:READ limit%(j%):NEXT
 370 IF sol%=0 THEN PRINT"NO SOLUTION FOUND"
 713 con%=FNtreesaw(np%,dep%)
 716 IF con%=0 THEN ENDPROC
2000 DEF FNtreesaw(np%,dep%)
2010 REM return 0 if current state looks bad
2020 REM otherwise return 1
2030 maxnp%=12:minx%=dx%:maxx%=0:miny%=dy%:maxy%=0:gflag%=1
2040 IF np%>maxnp% THEN =gflag%
2050 IF np%=1 THEN =0
2060 FOR ys%=0 TO dy%
2070   FOR xs%=0 TO dx%
2080     IF a%(xs%,ys%,dep%)<>1 GOTO 2130
2090     IF xs%<minx% THEN minx%=xs%
2100     IF xs%>maxx% THEN maxx%=xs%
2110     IF ys%<miny% THEN miny%=ys%
2120     IF ys%>maxy% THEN maxy%=ys%
2130     NEXT
2140   NEXT
2150 IF (maxx%-minx%+1)+(maxy%-miny%+1))limit%(np%) THEN gflag%=0
2160 IF gflag%=0 THEN vpos%=vpos%+1:IF vpos%>9 THEN vpos%=9
2170 IF gflag%=0 THEN PRINT"reject"
2180 =gflag%
2190 DATA 3,5,7,9,10,11,12,12,13,13,14
```

Listing 4 QL treesaw function

```
86 DIM limit%(12):FOR j=2 TO 12:READ limit%(j):END FOR j
165 IF sol%=0 THEN PRINT "NO SOLUTION FOUND"
381   con%=treesaw(np%,ac%)
382   IF con%=0 THEN RETurn
900 REMark ********************************************
1000 DEFine FuNction treesaw(np%,a%)
1010   REMark return 0 if current state of play looks bad
1020   REMark otherwise return 1
1025   maxnp%=12:minx%=dx%:maxx%=0:miny%=dy%:maxy%=0:gflag%=1
1030   IF np%>maxnp% THEN RETurn gflag%
1035   IF np%=1 THEN RETurn 0
1040   FOR ys=0 TO dy%
1050     FOR xs=0 TO dx%
1060       IF a%(xs,ys)=1 THEN
1070         IF xs<minx% THEN minx%=xs
1080         IF xs>maxx% THEN maxx%=xs
1090         IF ys<miny% THEN miny%=ys
1100         IF ys>maxy% THEN maxy%=ys
1110       END IF
1120     END FOR xs
1130   END FOR ys
1140   IF (maxx%-minx%+1)+(maxy%-miny%+1))limit%(np%) THEN gflag%=0
1160   IF gflag%=0 THEN PRINT "reject":BEEP 5000,250
1165   RETurn gflag%
1170 END DEFine treesaw
1180 DATA 3,5,7,9,10,11,12,12,13,13,14
```

Basic variables

QL	BBC	DESCRIPTON
dir$()	dir$()	String array holding directions: N,E,S,W
dx%	dx%	Maximum x coordinate on board
dy%	dy%	Maximum y coordinate on board
a%(,),ac%(,)	a%(,,)	Array containing board position(s)
np%	np%	Number of pins
x%,xx,xs	x%,xx%,xs%	X coordinate
y%,yy,ys	y%,yy%,ys%	Y coordinate
wx%	wx%	X coordinate of win hole
wy%	wy%	Y coordinate of win hole
sol%	sol%	Solution flag (=0 solution not found) (=1 solution found)
dep%,depc%	dep%	Depth of recursive calls
pr%	pr%	Counter for printing moves 4 per line
	vpos%	Print tabulator, text window
	lx%	Window position for board plotting (left)
	rx%	Window position for board plotting (right)
	ty%	Window position for board plotting (top)
	by%	Window position for board plotting (bottom)
dir%,rdir	dir%,dirc%	Direction of movement: 1,2,3,4
destx%	destx%	X coordinate of destination hole
desty%	desty%	Y coordinate of destination hole
skipx%	skipx%	X coordinate of skip hole
skipy%	skipy%	Y coordinate of skip hole
m%	m%	Number of states/positions found
con%	con%	Flag holding value returned by treesaw
chano%		Channel number for board plotting
startx%		X coordinate to start board plotting
starty%		Y coordinate to start board plotting
pitch%		Distance between holes - for plotting
rad%		Radius of holes - for plotting
maxnp%	maxnp%	Maximum number of pins considered by treesaw
minx%	minx%	Minimum x coord - for calculating sum of sides
maxx%	maxx%	Maximum x coord - for calculating sum of sides
miny%	miny%	Minumum y coord - for calculating sum of sides
maxy%	maxy%	Maximum y coord - for calculating sum of sides
gflag%	gflag%	Flag returned by treesaw (=0 cut branch) (=1 don't cut branch)
limit%()	limit%()	Array of limits on dispersal of pins

Parameters used to describe structure, relate to the following BASIC variables:

```
"state"      is comprised of - QL: a%(,), np%              BBC: a%(,,dep%), np%
"move"       is comprised of - QL: dep%, xx, yy, rdir      BBC: dep%, x%, y%, dir%
"new_state"  is comprised of - QL: ac%(,), np%             BBC: a%(,,dep%), np%
"new_move"   is comprised of - QL: depc%, xx, yy, rdir     BBC: dep%, xx%, yy%, dirc%
```

MS-DOS/Basic DOSLINK

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *6663 #

by LM Brann

The MS-DOS operating system provides a software interface between user-developed software and the machine's hardware — that is, disk storage, keyboard, display and peripheral devices. This software interface consists of a series of software routines to perform specific functions: for example, read keyboard, read/write disk, and so on. The DOS defines a standard software interface to these routines but has code specific to the hardware that the DOS is implemented upon. This ensures that user software will run on various hardware configurations without modification.

While operating within the Basic environment, direct access to DOS is not provided: the programmer is limited to the functions and facilities provided by the Basic language. Basic provides good access for the use of data files but has limitations that restrict its use for disk utility and management programs.

DOSLINK was developed to overcome this limitation: it is a short Basic subroutine that provides a link between Basic and the MS-DOS function calls. It allows the Basic programmer with little or no knowledge of assembly language to invoke various MS-DOS function calls to create utility and management programs that are not otherwise possible with Basic alone. Via DOSLINK, Basic can be used to access the disk directory, disk label, file attributes, time and date as well as direct sector access — all essential for the creation of disk library and management utilities.

MS-DOS can be viewed as a series of subroutines, each with a dedicated function. On entry certain variables are set up to define how the function is to perform; on exit the routine places the result of its function into variables. Normally the access to MS-DOS is at assembly language level and the necessary variables are passed using the CPU registers.

Recommended access to MS-DOS is via a special method of calling known as a software interrupt. The 8088/86-type CPU provides for a number of these, with its INT XX instruction where XX defines which software interrupt to execute. Whenever the CPU finds an INT instruction in its program, it transfers program control to the address specified in a special memory location called an interrupt vector.

Each of the INT instructions has its own associated vector. Those INTs used to interface to MS-DOS have a vector address to the MS-DOS function allocated to that interrupt. The operation of the software interrupt functions as a GOSUB in Basic: that is, when the end of the routine is reached, MS-DOS returns program control back to the calling program immediately after the software interrupt that invoked it. The use of this calling technique allows the detail of MS-DOS to be changed at any time without altering the way each function is invoked. This allows updates and correction of bugs to MS-DOS without the need to change the user programs.

To establish a working link between Basic and MS-DOS requires that Basic sets up the required entry data into the CPU registers, executes the appropriate software interrupt for the function required, and then reads back the resulting data from the CPU registers. DOSLINK achieves this by the use of a short machine code routine and the facilities of the Basic CALL statement.

The Basic CALL statement provides the facility to execute machine code programs from within Basic. It also allows the passing of pointers to the location of certain defined Basic variables on the CPU stack, thereby allowing the machine code routine to read and write data to and from Basic variables. Machine code programs can be stored in various ways for use by Basic. DOSLINK uses the area of memory allocated to an integer array.

DOSLINK allocates a group of Basic variables for the interface within the machine code program. To invoke any of the MS-DOS function calls or any software interrupt, the Basic programmer is required to set up the entry data in the correct Basic variables, make the Basic CALL to the DOSLINK machine code routine, and read the Basic variables on return. The following text defines those variables used by DOSLINK, and their application (note — all variables passed are integer type):

RAX	— passed to and from CPU reg AX
RBX	— passed to and from CPU reg BX
RCX	— passed to and from CPU reg CX
RDX	— passed to and from CPU reg DX
RDI	— passed to and from CPU reg DI
RSI	— passed to and from CPU reg SI
RFG	— receives a copy of CPU flag register on return
RES	— receives a copy of CPU segment register ES on return
FUN	— defines which software interrupt to execute

(On entry to the machine code routine, Basic sets all segment registers to point at Basic's data segment.)

Passing data to and from DOSLINK

As detailed above, Basic variables can be passed to a machine code program by the CALL statement of Basic. Prior to invoking the CALL to the machine code, the CALL statement places pointers to the variables to be passed to that routine onto the CPU stack. These pointers indicate where the actual data for the passed variables is stored in Basic's data segment. The machine code routine can, therefore, access data in each of the passed variables by these pointers.

The DOSLINK machine code expects to find pointers to Basic integer variables. Basic integer variables can be in the range -32768 to +32767, the actual value being stored in two bytes in 2's complement format. DOSLINK passes data from integer variables of this format to the CPU registers and back again. To set up the register values, it is recommended that the hexadecimal format is used — for example, &H1234. The following Basic statements can be used to convert between positive Basic floating point variables and integer variables for passing to and from DOSLINK:

To convert a positive decimal value in the range 0 to 65535 to an integer variable suitable for passing to DOSLINK:

```
RAX=XAX+(XAX>32767)*2^16
```

where RAX=integer variable to pass to DOSLINK
XAX=floating point variable (between 0 and 65535)

To convert an integer variable loaded by DOSLINK to a positive decimal value:

```
XAX=RAX+(RAX<0)*2^16
```

where XAX=floating point variable (between 0 and 65535)
RAX=integer variable loaded by DOSLINK

The 8088/86 CPU has 16-bit registers which can be accessed as two 8-bit registers. Register AX is a 16-bit register which can be accessed as two 8-bit registers called AH and AL, where AH is the 8 high bits of AX and AL is the 8 low bits. Registers BX, CX and

DX all conform to this convention. DOSLINK passes all CPU register data in 16-bit format as above. To determine the value to be passed to DOSLINK in terms of the high and low registers, use the following format:

XAX=XAH*256+XAL

where XAX is the 16-bit value passed to CPU reg AX by DOSLINK

XAH is the 8 bits for CPU reg AH

XAL is the 8 bits for CPU reg AL

Allocation of work areas for use by DOSLINK

For certain functions, MS-DOS requires work areas in memory through which it can transfer data to and from the calling routine: this is particularly so when using disk access functions. For an effective DOS to Basic link it is necessary to allocate those work areas in the Basic data segment, in the area normally used by Basic to store its variables. The most practical option is to allocate Basic string space as the work area; this then allows Basic to readily access the work area using the string operators. When Basic allocates a string variable, it stores that variable in the Basic data segment in the same way as a numeric variable, except that in place of the numeric value it stores a string descriptor. The actual data for the string is stored in a separate area. The string descriptor records the length of the data and points to its location in the data segment. Basic allows a maximum string length of 255 characters and is the preferred method of allocating work areas up to 255 bytes; however, for work areas of more than 255 continuous bytes, it is necessary to use string arrays. When the string space has been allocated, its memory location will need to be communicated to DOS via the various DOS function calls and DOSLINK.

Basic provides a function called VARPTR to allow the location of any of its variables to be found. The following example finds the location of WA$ in the Basic data segment and loads RDX ready to make a call to DOSLINK, a typical set-up prior to an MS-DOS call:

```
X=VARPTR(WA$):X=
PEEK(X+1)+PEEK(X+2*256:RDX=
X+(X>32767)*2^16
```

It is recommended that this statement be executed just prior to the DOSLINK call and must be executed after any redefinition of WA$ by Basic.

The following Basic statements show examples of work space allocation using both single strings and string arrays.

Allocation of a 128-byte work area in a single string:

```
WA$=SPACE$(128)
```

Allocation of an ASCIIZ string for transfer to DOS:

```
WA$="Filenam.xyz"+CHR$(0)
```

Allocation of a 1024-byte work area:

```
DIM WA$(63):FOR 1=63 to 0 STEP-1:WA$(1)=SPACE$(16):NEXT
```

The use of string arrays warrants special consideration and handling due to the way Basic allocates string space. When Basic allocates a new string or changes the contents of an existing one, it then finds the first free space in the string storage area and uses this, and sets the string descriptor accordingly.

Basic works from the top of available memory down in the allocation of string space. For this reason it is necessary to define the last element of the string array first to ensure that the array elements are stored from low memory to high memory, which is the convention that DOS will use for its work areas. It should be noted that when Basic allocates a string array, it is only the variable containing the string descriptor that will be stored in contiguous memory locations in the array table: the location of the actual string data can be stored in any part of Basic's string space. It is therefore essential, when defining a Basic string array for use as a work area, that the string data for each element be defined in turn and that no other string definition occurs between element definition. Consideration should also be given to the use of such a work area. If any single element of the array is redefined, then the data for that element will be allocated somewhere outside of the contiguous block of memory allocated as the work area. If Basic requires to write data into the work area, it is recommended that the POKE statement is used. The location of any element in the string array can be found with the following:

```
X=VARPTR(WA$(10)):X=
PEEK(X+1)+PEEK(X+2)*256
```

Care should also be taken with regard to the Basic's 'garbage collection' routines. As each string is redefined, the new contents are stored in the next free space of Basic's string space; the old data for the string remaining where it was. Eventually all of the available memory becomes full of string data, some of which is no longer valid. To enable Basic to continue working it performs an operation to 'clean up' the string space and remove all of the old string data, moving the valid strings to new destinations in memory.

Provided no further variable definition takes place after using VARPTR to find a string and prior to the information returned by VARPTR being used, no problems should occur. However, use the Basic function FRE(A$) to force a 'clean up' of string space prior to accessing any string data with VARPTR.

```
1000 ' *************************************************************
1010 ' *                                                           *
1020 ' *       DOS-LINK - A BASIC UTILITY SUBROUTINE               *
1030 ' *       ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~               *
1040 ' *                                                           *
1050 ' *       VERSION 02.00 01/10/86  (C) L.M.BRANN               *
1060 ' *                                                           *
1070 ' * PASSES DATA FROM BASIC VARIABLES TO THE CPU REGISTERS     *
1080 ' * EXECUTES THE SOFTWARE INTERRUPT DEFINED IN 'FUN'          *
1090 ' * RETURNS CPU REGISTER VALUES BACK TO BASIC VARIABLES       *
1100 ' *                                                           *
1110 ' * VALUES PASSED ON ENTRY                                    *
1120 ' *                      RAX TO CPU REG AX                    *
1130 ' *                      RBX TO CPU REG BX                    *
1140 ' *                      RCX TO CPU REG CX                    *
1150 ' *                      RDX TO CPU REG DX                    *
1160 ' *                      RDI TO CPU REG DI                    *
1170 ' *                      RSI TO CPU REG SI                    *
1180 ' *                                                           *
1190 ' * VALUES PASSED ON EXIT                                     *
1200 ' *                      CPU REG AX TO RAX                    *
1210 ' *                      CPU REG BX TO RBX                    *
1220 ' *                      CPU REG CX TO RCX                    *
1230 ' *                      CPU REG DX TO RDX                    *
1240 ' *                      CPU REG DI TO RDI                    *
1250 ' *                      CPU REG SI TO RSI                    *
1260 ' *                      CPU REG ES TO RES                    *
1270 ' *                      CPU REG FG TO RFG (FLAGS)            *
1280 ' *                                                           *
1290 ' * DOS-LINK ESTABLISHED BY CALL TO A SHORT MACHINE CODE      *
1300 ' * PROGRAM. THIS IS LOADED INTO INTEGER ARRAY A() PRIOR      *
1310 ' * TO MAKING A CALL TO THE DOSLINK SUBROUTINE.               *
1320 ' *                                                           *
1330 ' *************************************************************
1340 '
1350 ' *************************************************************
1360 ' *                                                           *
1370 ' *   DEFINE DOSLINK VARIABLES AND LOAD MACHINE CODE TO A()   *
1380 ' *   ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~   *
1390 ' *                                                           *
1400 ' * Execute this prior to the DOSLINK call.                   *
1410 ' *                                                           *
1420 ' *************************************************************
1430 '
1440 ' Load machine code program to array A()
1450 '
```

```
1460 DEFINT A,D,F,R
1470 RAX=&H0:RBX=&H0:RCX=&H0:RDX=&H0:RDI=&H0:RSI=&H0:RES=0:RFG=1:FUN=&05:DLINK=0

1480 DIM A(54):RESTORE 2080:FOR I=0 TO 54:READ A(I):NEXT:RETURN
1490 '
1500 ' ##################################################################
1510 ' #                                                                #
1520 ' # DOSLINK DATA CONVERSIONS .......                                #
1530 ' # ~~~~~~~~~~~~~~~~~~~~~~~~                                       #
1540 ' #~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~#
1550 ' #                                                                #
1560 ' # To convert floating point variable to integer format           #
1570 ' #                                                                #
1580 ' #   RAX=XAX+(XAX>32767)*2^16                                     #
1590 ' #                                                                #
1600 ' #   Where XAX = Floating Point Variable                          #
1610 ' #         RAX = Integer Variable to pass to DLINK                #
1620 ' #                                                                #
1630 ' #~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~#
1640 ' #                                                                #
1650 ' # To convert DLINK integer variable format to floating point     #
1660 ' #                                                                #
1670 ' #   XAX=RAX+(RAX<0)*2^16                                         #
1680 ' #                                                                #
1690 ' #   Where XAX = Floating Point Variable                          #
1700 ' #     RAX = Interger Variable to pass to DLINK                   #
1710 ' #                                                                #
1720 ' #~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~#
1730 ' #                                                                #
1740 ' # To find String variable contents and set a pointer to its     #
1750 ' # location in the BASIC Data Segment.                            #
1760 ' #                                                                #
1770 ' #  SADDR=VARTR(ST$):SADDR=PEEK(SADDR+1)+PEEK(X+2)*256            #
1780 ' #                                                                #
1790 ' #  Where ST$ is string variable                                  #
1800 ' #        SADDR is a floating point variable                      #
1810 ' #                                                                #
1820 ' ##################################################################

1830 '
1840 ' ##################################################################
1850 ' #                                                                #
1860 ' #     DOSLINK SUBROUTINE (LINK TO DOS)                           #
1870 ' #     ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~                           #
1880 ' #                                                                #
1890 ' # Assembly language loaded to interger array a()                 #
1900 ' #                                                                #
1910 ' # ENSURE ALL VARIABLES PASSED ARE DEFINED PRIOR TO ENTRY        #
1920 ' # ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~        #
1930 ' #                                                                #
1940 ' # On entry RAX, RBX etc holds register entry values              #
1950 ' #          FUN holds the DOS INT for the required function       #
1960 ' #                                                                #
1970 ' ##################################################################

1980 '
1990 DLINK=VARPTR(A(0)):CALL DLINK(DLINK,FUN,RAX,RBX,RCX,RDX,RSI,RDI,RES,RFG)
2000 RETURN
2010 '
2020 ' ##################################################################
2030 ' #                                                                #
2040 ' #     MACHINE CODE DATA FOR DOSLINK - LOAD TO ARRAY A()          #
2050 ' #                                                                #
2060 ' ##################################################################

2070 '
2080 DATA &H8B55,&H06EC,&H5E8B,&H8B0C,&H8B37,&H0A5E,&H3F8B,&H5E8B,&H8B18,&H0507
2090 DATA &H003B,&HC88B,&H5E8B,&H8B16,&H8B07,&H8BD9,&H8B07,&H0E5E,&H178B,&H5E8B
2100 DATA &H8B10,&H8B0F,&H145E,&H078B,&H8B50,&H125E,&H078B,&HD88B,&H5558,&H05CD
2110 DATA &H535D,&H5E8B,&H890C,&H8B37,&H0A5E,&H3F89,&H5E8B,&H890E,&H8B17,&H105E
2120 DATA &H0F89,&H5E8B,&H8914,&H8B07,&H125E,&H8958,&H8B07,&H065E,&H589C,&H0789
2130 DATA &H5E8B,&H8C08,&H0707,&HCA5D,&H0014
2140 '
2150 '~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
2160 '
```

Excel Macro Rule Inference

by Jack Weber

This is the program which accompanies Jack Weber's article, 'Working to Rule' (see page 129), on rule induction from within a spreadsheet using its macro language

	A	B
1	Rule Induction	
2		
3	© Jack Weber January 1987	
4		
5	**Program**	
6	count the number of allowed values for each attribute	
7	=SELECT(!$B$12:$F$12)	select cells to take counts
8	=FORMULA.FILL("=Macros!Countup(R[-10]C:R[-1]C)")	call function to count the 10 rows above
9	count the number of attributes	
10	=SET.VALUE(A13,1)	set loop to do columns: 1 - 4
11	=SET.NAME("attributes",0)	initialise counter
12	=SET.NAME("attributes",attributes+SIGN(INDEX(!$B$12:$E$12,A13)))	increment count if values present
13	=A13+1	increment column loop
14	=IF(A13<5,GOTO(A12))	do next column
15	count the number of examples	
16	=SELECT(!$B$33:$F$33)	select cells to take counts
17	=FORMULA.FILL("=Macros!Countup(R[-20]C:R[-1]C)")	call function to count the 20 rows above
18	work out the entropy of each attribute value	
19	=SELECT(!$B$34:$E$43)	select cells to take entropy table
20	=FORMULA.FILL("=Macros!Entropies(RC,1,20)")	call function to find entropy of each value
21	work out the overall entropy of each attribute	
22	=SELECT(!$B$44:$E$44)	select cells to take attribute entropies
23	=FORMULA.FILL("=Macros!Sumentropies(RC)")	call function to find entropy of each column
24	sort all the attribute columns in order of increasing entropy	
25	=SELECT(!$B$1:$E$44,!$B$44)	select value, example & entropy tables
26	=SORT(2,"R",1)	sort attributes by entropies in bottom row
27	Now that attribute columns are sorted into a classification hierarchy,	
28	sort examples according to their entropies within each column.	
29	Begin by creating a sort key based on the first attribute.	
30	=SELECT(!$G$13:$G$32)	select first sort key column
31	=FORMULA.FILL("=Macros!Classify(RC)")	call function to get corresponding entropies
32	=SELECT(!$B$13:$G$32)	select whole example table and key
33	=SORT(1,"C[5]",1,"C",1)	sort by: 1-key, 2-1st attribute values
34	Initialise remaining sort keys to zero.	
35	=SELECT(!$H$13:$K$32)	select remaining sort keys
36	=FORMULA.FILL("=Macros!Keyfill(RC)")	call function to fill with 0 (#NA if empty)
37	To create sort keys, look at entropy in previous key column - branches of the	
38	decision tree appear as blocks of one entropy value. Find first and last items	
39	in block. If its entropy=0 no more work is required, else classify and sort	
40	that block according to values of current attribute.	
41	=SET.VALUE(A61,2)	set loop to do columns: 2 - no. of attributes
42	=SET.NAME("start",1)	initialise "start" of block to 1
43	=SET.NAME("blockentropy",INDEX(!$G$13:$J$32,start,A61-1))	init. "blockentropy" to entropy in last column
44	=SET.VALUE(A46,start)	set loop to do rows:"start" - no. of egs.
45	=IF(INDEX(!$G$13:$J$32,A46,A61-1)<>blockentropy,GOTO(A48))	end of block reached? If so, exit loop
46	=A46+1	increment example loop
47	=IF(A46<=!$B$33,GOTO(A45))	do next example
48	=SET.NAME("finish",A46-1)	set end of current block
49	=IF(INDEX(!$G$13:$J$32,start,A61-1)=0,GOTO(A57))	if entropy=0 skip to next block
50	=IF(ISNA(INDEX(!$G$13:$J$32,start,A61-1)),GOTO(A57))	skip blank rows
51	=SELECT(INDEX(!$B$34:$E$43,0,A61))	select current column in entropy table
52	=FORMULA.FILL("=Macros!Entropies(RC,Macros!start,Macros!finish)")	call function to calculate block entropies
53	=SELECT(INDEX(!$G$13:$J$32,start,A61):INDEX(!$G$13:$J$32,finish,A61))	select block in current key column
54	=FORMULA.FILL("=Macros!Classify(RC)")	call function to get corresponding entropies
55	=SELECT(INDEX(!$B$13:$J$32,start,0):INDEX(!$B$13:$J$32,finish,0))	select block across examples & keys
56	=SORT(1,INDEX(!$G$13:$J$32,0,A61),1,INDEX(!$B$13:$E$32,0,A61),1)	sort by: 1-key, 2-attribute
57	=IF(A46>=!$B$33,GOTO(A61))	last eg. reached? If so, go to next column
58	=SET.NAME("start",finish+1)	set "start" for next block
59	=SET.NAME("blockentropy",INDEX(!$G$13:$J$32,start,A61-1))	set "blockentropy" for next block
60	=GOTO(A44)	go back to example loop
61	=A61+1	increment column loop
62	=IF(A61<attributes+1,GOTO(A42))	do next attribute column

	A	B
63	All attributes are now classified but some branches of tree still may not be	
64	resolved if conflicting data was present. Check if non-zero entropies remain.	
65	If so, offer user choice to remove them or incorporate them into rule.	
66	=SUM(INDEX(!$G$13:$J$13,attributes):INDEX(!$G$13:$J$32,!$B$33,attributes))	sum of entropies in final attribute key
67	=IF(A66=0,GOTO(A82))	no conflict if sum=0, so skip next section
68	=ALERT("Remove conflicting data?",1)	conflicts present so offer to remove them
69	=IF(A68=FALSE(),GOTO(A82))	leave conflicts, so skip next section
70	Remove conflicting data from example table.	
71	=SET.VALUE(A75,1)	set loop to do example rows: 1 - no. of egs.
72	=IF(INDEX(!$G$13:$J$32,A75,attributes)=0,GOTO(A75))	final entropy=0? If so, skip to next example
73	=SELECT(INDEX(!$B$13:$K$32,A75,0))	select whole example row
74	=FORMULA.FILL("=NA()")	replace with #NA to allow sorting out
75	=A75+1	
76	=IF(A75<=!$B$33,GOTO(A72))	do next example row
77	=SELECT(!$B$33:$F$33)	recount number of examples
78	=FORMULA.FILL("=IF(SIGN(R[-21]C)=1,Macros!Countup(R[-20]C:R[-1]C),0)")	and enter new counts under example table
79	=SELECT(!$B$13:$K$32)	select all examples and keys
80	=SORT(1,"C[5]",1,"C[6]",1,"C[7]",1)	sort by keys to shift down deleted lines
81	Final attributes may not be contributing. Count number of significant attributes.	
82	=SET.VALUE(A84,1)	set loop to do attribute columns: 1 - 4
83	=SUM(INDEX(!$G$13:$J$13,A84):INDEX(!$G$13:$J$32,!$B$33,A84))	add up entropies in that column
84	=A84+1	increment column loop
85	=IF(A83=0,GOTO(A87))	1st all zero col. was reached, so exit loop
86	=IF(A84<5,GOTO(A83))	do next column
87	=SET.NAME("attributes",A84-1)	set new value of "attributes"
88	Rearrange sort order of first attribute according to number of steps needed	
89	to resolve the branch fully. For each block, a ranking key is set up showing	
90	average number of extra attributes needed to resolve it.	
91	=SET.NAME("start",1)	initialise "start" of block to 1
92	=SET.NAME("blockvalue",INDEX(!$B$13:$B$32,start))	init. "blockvalue" to 1st value of 1st attrib.
93	=SET.VALUE(A95,start)	set loop to do examples:"start" - no. of egs.
94	=IF(INDEX(!$B$13:$B$32,A95)<>blockvalue,GOTO(A97))	end of block reached? If so, exit loop
95	=A95+1	increment example loop

	A	B
207	**Countup**	
208	Counts number of items in the column range specified	
209	=ARGUMENT("range",8)	argument is a range of cells in one column
210	=ROWS(range)	number of rows in range
211	=SET.NAME("counter",0)	initialise "counter" to zero
212	=SET.VALUE(A215,1)	set loop to do rows: 1 - length of range
213	=IF(ISNA(INDEX(range,A215)),GOTO(A215))	skip empty cells
214	=SET.NAME("counter",counter+1)	increment count
215	=A215+1	increment loop
216	=IF(A215<=A210,GOTO(A213))	do next row
217	=RETURN(counter)	return value of count
218	**Entropies**	
219	Calculates entropies for each attribute value between "first" and "last"	
220	=ARGUMENT("cell",8)	1st argument is reference to calling cell
221	=ARGUMENT("first",1)	2nd argument - begin with this example
222	=ARGUMENT("last",1)	3rd argument - finish with this example
223	=SET.NAME("entropy",0)	initialise variable for summing entropy
224	=IF(OFFSET(cell,12-ROW(cell),0)=0,RETURN(NA()))	skip empty columns
225	=OFFSET(cell,-32,0)	point to attribute value
226	=IF(ISNA(A225),RETURN(NA()))	skip blank attribute values
227	=SET.VALUE(A244,1)	set loop to do outcome values 1 - 10
228	=INDEX(!$F$2:$F$11,A244)	point to reference outcome value
229	=IF(ISNA(A228),GOTO(A244))	skip blank outcome values
230	=SET.NAME("occurence",0)	init. counter for matching outcomes to 0
231	=SET.NAME("totalnumber",0)	init. counter for matching attr values to 0
232	=SET.VALUE(A238,first)	set loop to do example rows "first" - "last"
233	=INDEX(!$B$13:$E$32,A238,COLUMN(cell)-1)	point to example attribute value
234	=IF(ISNA(A233),GOTO(A238))	skip blank examples
235	=INDEX(!$F$13:$F$32,A238)	point to example outcome
236	=IF(A233=A225,SET.NAME("totalnumber",totalnumber+1),GOTO(A238))	if attrib. matches, increment "totalnumber"
237	=IF(A235=A228,SET.NAME("occurence",occurence+1))	if outcome matches, increment "occurence"
238	=A238+1	increment example loop
239	=IF(A238<=last,GOTO(A233))	do next example
240	=occurence/totalnumber	probability
241	=(A240)*LOG10(A240)/LOG10(2)	sub-entropy
242	=IF(ISERROR(A241),SET.VALUE(A241,0))	fix (/0)error caused by probability=0
243	=SET.NAME("entropy",entropy-A241)	add to total entropy for this value
244	=A244+1	increment outcome loop
245	=IF(A244<11,GOTO(A228))	do next value of outcome
246	=RETURN(entropy)	return value of entropy

	A	B
247	**Sumentropies**	
248	Combines entropies for each value of an attribute to give an overall entropy	
249	that can be used to sort attributes into classification order	
250	=ARGUMENT("cell",8)	reference to calling cell
251	=SET.NAME("columnentropy",0)	set entropy accumulator to zero
252	=IF(OFFSET(cell,-32,0)=0,RETURN(NA()))	if no attribute present, return #NA
253	=SET.VALUE(A264,1)	set loop to do attribute values: 1 - 10
254	=INDEX(!$B$2:$E$11,A264,COLUMN(cell)-1)	point to attribute value
255	=IF(ISNA(A254),GOTO(A264))	skip blank values
256	=SET.VALUE(A260,1)	set loop to do examples. 1 - no. of egs
257	=SET.NAME("counter",0)	initialise "counter" to zero
258	=INDEX(!$B$13:$E$32,A260,COLUMN(cell)-1)	point to example
259	=IF(A258=A254,SET.NAME("counter",counter+1))	if example matches value, increment count
260	=A260+1	increment example loop
261	=IF(A260<=!$B$33,GOTO(A258))	do next example
262	=(counter/OFFSET(cell,-11,0)*OFFSET(cell,A264-11,0))	sub-entropy
263	=SET.NAME("columnentropy",columnentropy+A262)	add to columnentropy
264	=A264+1	increment attribute value
265	=IF(A264<=INDEX(!$B$12:$E$12,COLUMN(cell)-1),GOTO(A254))	do next attribute value
266	=RETURN(columnentropy)	return columnentropy
267	**Classify**	
268	Creates sort keys by returning entropy corresponding to current attribute value	
269	=ARGUMENT("cell",8)	reference to calling cell
270	=OFFSET(cell,0,-5)	point to example
271	=MATCH(A270,INDEX(!$B$2:$E$11,0,COLUMN(cell)-6),0)	index of corresponding value
272	=INDEX(!$B$34:$E$43,A271,COLUMN(cell)-6)	gives its entropy
273	=RETURN(A272)	return the entropy
274	**Keyfill**	
275	Fills remaining sort keys by returning zero if example present, #NA if not	
276	=ARGUMENT("cell",8)	reference to calling cell
277	=IF(ROW(cell)<!$B$33+13,RETURN(0),RETURN(NA()))	if eg. present, return 0, if not return #NA
278	**Ranking**	
279	Creates key by returning ranking average if example present, #NA if not.	
280	=IF(ISNA(blockvalue),RETURN(NA()),RETURN(A106))	if eg. present, return rank else return #NA

Go by the board

This month, Steve Withers gives a run down on downloading software for first-time users, and presents a full listing of BBSs Australia wide.

In the last two Communications columns, a fair amount of space has been devoted to the technical background to file transfer. The most common reason for putting the theory into practice is to download software from a bulletin board.

Most (but not all) BBSs offer a range of downloadable software; either public domain, or shareware. The difference between the two categories is that public domain software is free (although you can sell it to someone if they are mug enough), whereas shareware is offered on free approval. If you decide to use the program, you send payment to the author. Some people who choose to distribute their creations by the shareware method permit third parties to levy a 'copying fee', others do not.

When BBSs started, we were in the Z80/6502 era — a 30k program was considered fairly large. Today, it's not hard to find programs for MS-DOS systems or the Macintosh that are ten times that size, especially if you include the documentation.

Modem technology has been improved in that time, but there are relatively few hobbyists that have moved up to 2400 baud. If you want to download a big file at low speeds, I'd suggest it would be a courtesy to other users if you pick a time when the board is lightly used. This generally means daylight hours during school terms! Think about the alternatives to downloading, such as the software library of your local users' group, or (usually at greater cost) one of the commercial or semi-commercial distributors of this type of software, several of which advertise regularly in *APC*.

Downloading is a legitimate exercise — otherwise sysops wouldn't allow it on their systems. Even at 300 baud, it's faster than waiting for a disk to come in the mail, or for the next club meeting. You also stand more chance of finding the latest and greatest on a BBS.

Once you have an appropriate piece of communications software, downloading is pretty simple. Just about every BBS which allows downloading supports the Xmodem protocol (see Communications, June 1987), so that's probably the best to pick for your first attempts.

It's also a good idea to start with a small file. When you've found a candidate, you tell the BBS that you want to download it. The command varies between systems, but it's usually something sensible like 'D' for download. Then you must tell your terminal program that it is to receive a file. Again, the commands vary, but normally one or two keystrokes are all that is required (for example, Procomm uses the PageDown key). With Xmodem, you'll need to tell your computer what to call the incoming file, but other protocols transfer the file name along with the data. From here on, the programs do all the work.

Normally some indication of progress comes onto the screen so you know something is happening. You may get a bad block or two, but Xmodem takes care of things for you. The transfer will be aborted if too many errors occur. This can happen with a very poor phone line, but a more likely cause is some mismatch between the communications settings of your computer and those required by the BBS. The fact that terminal communications were OK does not necessarily mean that file transfer will work.

It isn't easy to give general advice about the problems that can occur, other than to suggest checking that your software is set to use eight data bits and no parity. If the problem persists, you could leave a message asking for help from other users of the board. If you describe your difficulty along with the hardware and software combination, there's a good chance that someone will be able to help you.

Unfortunately, I must end by pointing to the risk you run by using public domain software. The risk is slight, but it can be catastrophic. There are a few warped individuals who get their kicks by writing and distributing programs that sound innocuous, but actually do something nasty like reformatting your hard disk. These people have been described as the electronic equivalent of seat-slashers, but I think that's a bit mild.

Such programs are rare and they tend to be identified quickly, but you don't want to be the one who discovers them the hard way. There are programs around that help you spot potentially hazardous code, but they offer little protection against a devious programmer. The notorious NOTROJ (troj being short for 'Trojan horse') was supposed to stop programs wreaking havoc on your system, but was actually a true Trojan horse — not a gift, but a cunning assault.

Don't let me put you off public domain software, but do use it with your eyes open.

Getting connected

Have you ever called a bulletin board only to see your modem's carrier detect light go out as soon as you press a key? If this does happen, don't hang up too quickly. Some multi-speed modems can take several seconds to match speeds with the calling system, so be patient. Although it's only a matter of seconds, it sometimes seems like an age!

Mystery correspondent

If you are the person who recently wrote to me about a certain Telecom by-law, would you please write again to tell me which bulletin board I can use to reply to your questions.

System news

Thanks to Mike Lewis and Greg Noonan for providing information included in this month's full listing of Australian BBSs. If your favourite sys-

tem isn't here, please drop me a line at the address at the end of the article. The same request applies if a system has gone off-line, or if you spot a mistake in an entry.

Mike mentioned that he has taken his system (Mike's Bullboard) off-line because of the misuse that has occurred, and in anticipation of Telecom's new charging scheme. First a trickle, then a flood?

NSW

Ace (02) 560 9846. MV. Jeff Maddock. 6pm-9am weekdays, 24 hours weekends.
Adventure Line (02) 636 9027. MV. 10pm-5pm weekdays, 10pm-8am weekends.
AED-Prophet (02) 628 5222. MV. Larry Lewis. 24 hours daily. V21, V22, V22bis, V23.
Amstrad (02) 981 2966. M. Riccey Schmahl. V21, V22, V23.
Arco-Tel (02 683 3956. MV. Alex Szx. 24 hours daily. V21, V22, V22bis, V23.
AUGABBS (02) 451 6575. MV. Matthew Barnes and Andrew Riley. 24 hours daily. V21, V22, V22bis, V23.
Augur (02) 661 4739. MV. Mark James. 24 hours daily.
Ausborne (02) 439 7072. MV. Ausborne Ltd. 24 hours daily.
Australian Pick Users' (02) 631 8603. MV. Kurt Johannessen. 24 hours daily. V21, V22, V22bis.
Auz Line (02) 636 9027. 24 hours daily.
Bee-Hive (02) 520 5181. P. Paul Pinches. 9am- 6pm Friday-Monday.
BERT (02) 211 0855. P. Resource Data. 24 hours daily. V23 videotex.
Books (02) 525 5781. P. Chris Ruwoldt. 24 hours daily. V21, V22, V22bis, V23. FidoNet node 712/503.
Bounty (02) 918 3256. MV. David Lloyd. 24 hours daily.
Club Amiga (02) 521 6338. MV. Ross Kellaway. 24 hours daily. V21, V22. Amiga and C64.
Club Mac (02) 73 1992. MV. Jason Haines. 24 hours daily. V21, V22, V22bis, V23.
Club 80 (02) 332 2494. MV. Michael Cooper. 24 hours daily. V21, V23.
Color Connection (02) 618 3591. MV. Barry Dornton. 24 hours daily.
Comet (02) 599 7342. MV. Eric Davis. 24 hours daily.
Comm Link (02) 875 4817. MV. Michael Hayter. 24 hours daily.
Commodore 64 (02) 664 2334. MV. Barry Dornton. 24 hours daily.
Computer Connection (02) 57 2463. M. Hamish Bowly. 24 hours daily.
Contact (02) 550 1004. MV. Steven Williams. 24 hours daily. V21, V22, V23, Bell 103. Computer dating.
Csace (02) 529 8249. MV. Larry O'Keefe. 24 hours daily.
Datacom (02) 643 1220. MV. James Butler.
Dick Smith Electronics (02) 887 2276. P. Mark Grimmond. 24 hours daily.
Dingo's Den (02) 888 2203. MV. David Harvey. V21, V22, V23. FidoNet.
Dymock's Computer Bookline (02) 232 3061. MV. Bob Green. 10am-8.30pm weekdays, 24 hours weekends. V21, V22, V23.
Eagle's Nest (02) 451 0535. MV. Philip Dean. 24 hours daily.
Fantasy (02) 93 5225. MV. 9pm-7.30am daily.
Fido Australia (02) 959 3712. B and L Gatenby, R. Morgan. 24 hours daily. V21, V22, V22bis. FidoNet.
Galaxy (02) 875 3943. MV. Chris Nelligan. 24 hours daily.
Idiom (02) 438 4060. MV. Stephen Beeby. 24 hours daily. V22, V22bis.
Info Centre (02) 344 9511. MV. Paris Radio. 24 hours.
Information Connection (02) 521 1359. Roy King. 24 hours daily.
InterTan (02) 625 8071. MV. 24 hours daily.
Laser Line (02) 997 6820. MV. Ward Britton. 24 hours daily. V21, V22, V22bis, V23.
MacBBS (02) 623 2287. P. Ed Cox. Nearly 24 hours daily. V21, V23.
Manly (02) 977 6820. MV. Chris Patten. Requires Rterm or Ultraterm on C64.
Micro Design Lab (02) 663 0150, (02) 663 0151. P. Kevin Lowton. 24 hours daily.
Micro Mart C Users' (02) 560 3607. MV. Rick Polito. 24 hours daily. V21, V22, V22bis, V23.
NABA-Prophet (02) 628 7030. MV. Larry Lewis. 24 hours daily. V21, V22, V22bis. FidoNet. 712/606.
Nebula (02) 407 2729. MV. Sean Craig.
NSW Ace (02) 529 2059. MV. Larry O'Keefe. 24 hours daily.
Omega Line (02) 457 8281. P. Geoff Arthur. 24 hours daily. V21, V22, V23. A FidoNet system.
Omen I (02) 498 2495. MV. Ted Romer. 4.30pm-9am weekdays, 24 hours weekends. V21, V23.
Palantir (02) 451 6576. P. Steve Sharp. 24 hours daily. V21, V22, V23.
Paragon (02) 597 7007. MV. Jennifer Allen. 24 hours daily. V21, V22, V22bis, V23. FidoNet 712/502.
Phantom Land (02) 399 7716. MV. Bob James. 24 hours daily.
Playground (02) 53 9688 MV. Brett Selwood.
Pursuit (02) 522 9507. MV. Warren Hillsdon. 24 hours daily.
RCOM (02) 667 1930. MV. Simon Finch. 24 hours daily. Must use Commodore 64 with RTerm software.
Realtors (02) 387 5335. Gary Stern. 24 hours . V21, V22, Bell 103, Bell 212.
Renegade (02) 631 2715. P. Sam Sarkis. V21, V22, V22bis, V23. A FidoNet system.
RUNX Unix System (02) 487 2533. MV. Mark Webster. 24 hours daily. Call (02) 48 3831 for system status. Also on (02) 48 3831 (V22) and (02) 487 1860 (V23).
Samilon FidoNet (02) 80 3681. MV. Brian Houlahan. 24 hours daily.
Sci-Fi (02) 646 4865. P. Greg Hope. 24 hours daily. V21, V22, V23.
Scitec Olympic (02) 427 1212. 24 hours daily. V21, V22, V22bis. FidoNet.
Scorpio (02) 621 7487. MV. Russ Morrison. 24 hours daily. C64, full access $25 — contact 64 Blacktown Users Group.
Sendata (02) 438 4060. P. Stephen Beeby. 24 hours daily. V21, V22, V22bis, V23. Voice: (02) 438 4255.
Sentry (02) 428 4687. MV. Trev Roydhouse. 9pm- 6am weekdays. 8pm-6am weekends. FidoNet.
SMUG-Bee (02)607 7584. MV. Bob Fryer. 24 hours daily.
Software Connection (02) 451 2954. MV. Graeme Nichols. 24 hours daily. V21, V22, V22bis, V23. FidoNet 711/404.
Software Tools (02) 449 2618. MV. Bill Bolton. 24 hours daily. V22, V22bis, Trailblazer 9600 only. FidoNet 711/403.
Sorceror Users Group (02) 626 8020. MV. John Cepak. 24 hours daily.
The Spring Board (02) 533 1482. MV. Dr Vector. 24 hours daily.
Sydney PC Users Group (02) 238 9034. MV. Geoff May. 24 hours daily. Also on (02) 221 5520 for V22. Bytenet listings.
Syntax's Error (02) 645 3406. MV. 24 hours daily.
Tachyonics (02) 438 2682. MV. Richard Lenz. 24 hours. V21, V22. FidoNet.
Tesseract (02) 651 1404. MV. John Hastwell- Batten. 24 hours daily. V21, V22, V22bis, V23.
Warringah (02) 977 0323. MV. Bryan Wilde. 24 hours daily. V21, V22, V23, Bell 103, Bell 212, FidoNet.
Zenith (02) 477 7509. Tony Callahan. 24 hours daily.
Zeta (02) 627 4177. MV. Nick Andrew. 24 hours weekdays. 7pm-7am weekends. V21, V22, V22bis, V23, Bell 103 and 212.
Abcom (047) 36 4165. MV. Ben Sharif. 24 hours daily. V21, V22.
Appletech (042) 71 5514. MV. Peter Tomlin. 8pm-11pm weekdays, 6pm-midnight weekdays.

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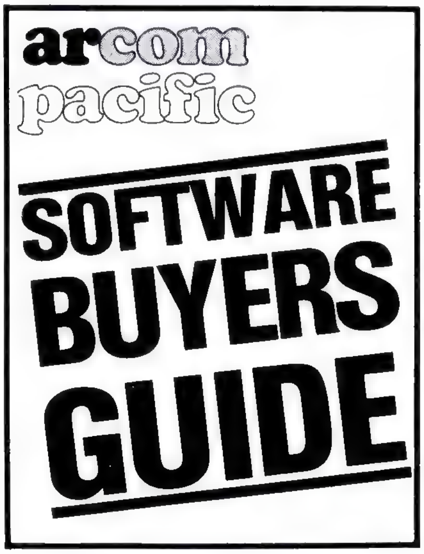

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Griffith Computer Association BBS P. (069) 62 7272. Greg Bodger. Ring-back system. Program downloading.
Illawarra (042) 61 8230. MV. John Simon. 24 hours daily.
Infocom (042) 61 5094. 24 hours daily.
Jupiter (063) 31 5041. P. John Dyson. 9pm-10.30pm daily. Phone will be answered by a person.
Newcastle Microcomputer Club RCPM RBBS (049) 68 5385. MV. Tony Nicholson. 5pm-8.30am weekdays, 24 hours weekends. RBBS free to all; RCPM for members only — $4/year to PO Box 293, Hamilton, NSW 2303.

ACT

ACT Amiga Users' Group (062) 59 1137. MV. Mike Hurst-Meyers. 24 hours daily. V21, V22, V23.
ACT Pharmacy (062) 92 3875. Michael Pye. FidoNet 626/223.
Commodore User Group (ACT) (062) 810 847. MV. James Hacker. 24 hours daily.
Comtel (062) 59 1244. MV. Warren Mason. 24 hours daily.
Data-Link (062) 99 1543. MV. Fred Flintstone. 24 hours daily.
Gateway (062) 88 0024. P. James Collins. 24 hours daily. V21, V22, V23.
MICSIG (062) 85 1026. P. Ross Elliot. 24 hours daily. V21, V22, V23.
PC Exchange (062) 58 1406. MV. Phil Harding. 24 hours daily. V21, V22, V22bis, V23.
Professional Computer Users' Group (062) 59 1244. MV. Alan Salmon. 24 hours daily. V21, V22, V22bis, FidoNet.

Vic

ABE (03) 288 3599. P. Richard Gardiner. 24 hours daily. V21, V22.
Aces High (03) 878 2918. 24 hours daily. V21, V22, V23.
AmigaLink (03) 792 3918. Bohdan Ferens. 24 hours daily. V21, V22, V23. A FidoNet system.
AM-NET (03) 366 7055. Peter Haligarten. 24 hours daily. V21, V23, and packet radio.
Atlantis International (03) 277 6824. P. John Edwards. 24 hours daily. V21, V22.
AUSOM (03) 877 1990. MV. Grahame Willis. 24 hours daily.
AUSOM MacSIG (03) 435 9152. P. 24 hours daily. V21, V22.
BERT (03) 602 1552. P. 24 hours daily. Business and economic news. Also on (03) 67 7371 for V23/Videotex users.
BUGM (03) 500 0562. P. Sol Green. Midnight-6pm Monday-Saturday, Midnight-Midday Sunday.
C64-BBS (03) 489 4557. MV. Alan Miles. 24 hours daily. Commodore 64 software up/downloading.
Custom Programming (03) 848 3331. P. Alan Williamson. 24 hours daily.
Cycom (03) 727 1018. Darren Huyson. 6pm-6am daily. V21, V22, V23.
DECUS Melbourne (03) 63 9133. Jay Ondracek, 24 hours daily. V21, V22, V23, V22bis. DECUS members only (but membership is free), caters for Rainbows to VAXes, public domain software downloading (CP/M and MS-DOS). FidoNet 155/310.
Down Under Software #1 (03) 429 8079. P. Greg Hudson. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/307.
Down Under Software #2 (03) 429 5819. P. Greg Hudson. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/306.
Duncan (03) 602 5200. P. 24 hours daily. Computer news and advertising.
Eastcom (03) 288 0775. P. Maurice Halkier. FidoNet 630/312.
Eastwood (03) 870 4623. M. Mick Stock. 4pm-midnight. Monday-Friday ONLY. V21 originate or answer.
Electronic Cross-Over (03) 367 5816. Stephen Paddon. 24 hours daily.
Info-Source (03) 397 1165. MV. Clement Maloney. 24 hours daily. V21, V22, V22bis, V23. Bell 103 & 212A. FidoNet (soon).
Magic Pudding (03) 428 2178. P. Rupert Russell. 24 hours daily. V21, V22, V23 (Nice Modem II).
MICOM CBMS (03) 762 5088. MV. Peter Jetson. 24 hours daily.
MicroBee (03) 82 1571. Mike Thompson. 24 hours daily.
Microlink (03) 233 0230. P. Mike Thompson. 24 hours daily. V21, V23.
Midnight Frog (03) 596 1589. Scott Enwright. 24 hours daily. V21, V22, V22bis, V23. A FidoNet system.
National (03) 25 6904. P. John Blackett-Smith. 24 hours daily. V21, V22, V22bis. FidoNet 630/301.
Osborne Australia (03) 529 3519. MV. Craig Orr.
The Outer Limits (03) 725 6650. P. Captain Kirk. 5pm-6am weekdays, 24 hours weekends. Science fiction: stories, quiz and reviews.
Pacific Island (03) 890 2174. P. Craig Bowen. 24 hours daily.
PC-Connection (03) 528 3750. MV. Lloyd Borrett. 24 hours daily. V21 and V22.
PC Domain (03) 789 8918. P. Daryl Clayton. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/320.
Public Resource #1 (03) 878 2918. P. D Harvey. 24 hours daily. V22 and Bell 103.
Public Resource #2 (03) 690 7220. P. D Harvey, W Clarke, R Nagy. 24 hours daily.
The Real Connection (03) 288 0331. P. Carla Miller, Andrew Moore. 24 hours daily. A FidoNet system.
Sam's (03) 563 1117. P. Alan Haslar. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/305.
SCUA (03) 754 5081. MV. David Woodberry. 24 hours daily. Public domain software downloading for members of Sorcerer and CP/M Users of Australia, Inc.
Sendata (03) 568 0794. P. Richard Budge. 24 hours daily. V21, V22, V22bis, V23. Voice: (02) 568 6299.
Silicon Valley (03) 427 0297. 24 hours daily. V22 only; V22bis only on (03) 427 0306. Use VT100/ANSI terminal emulation.
Supermicros (03) 799 2001. Richard Tolhurst. 24 hours daily. Also on (03) 799 2041 for V21, V22, V23.
Telegraph Road (03) 743 6173. MV. Kit. 24 hours daily.
Ten to One Amiga (03) 762 9761. Mike Beckett. 24 hours daily.
TrainerLink (03) 877 5568. MV. Len Gould. 24 hours daily. V21, V22, V22bis, V23.
Ultimate C64 (03) 735 5551. Mike Kabiolke. 24 hours daily. V21, V22, V22bis, V23.
Zoist (03) 467 2871. Bob Fletcher. 24 hours daily.
Abacus (057) 83 1964. P. Maurice Copeland. 8am-noon, 4pm-11pm daily. V21, V23 (with auto backchannel).
Bayside Fido (052) 51 4110. 'Paddy'. 24 hours daily. V21, V22, V23.
Mail-Bus (051) 27 7245. MV. Max Moore. 24 hours daily. Now allows non-members to read and reply to bulletin board messages.
MIN-NET (054) 41 3013. MV. Mal Fields. 24 hours daily. Enquiries to (054) 43 2589 during business hours ONLY.
Omega (052) 22 1670. Mark Gregson. 7pm-2am daily.

Qld

AM-PAK (07) 263 7070. MV. John Bews and Brian Wendt. 24 hours daily. V21, V22, V22bis, V23 and packet radio.
BEX II (07) 808 2125. MV. Rick Dalley. 24 hours daily. User Works Node 4.
BMUG (07) 38 4833. MV. Sid Young. 24 hours daily. V21, V23.
CCUG (07) 808 2125. Ray King. 24 hours daily.
Connect-64 (07) 393 5352. Craig Upton. 7pm-7am weekdays, 24 hours weekends.
Corplex Retailing (07) 350 1300. Scott

Pierce and Lloyd Ernst. 6pm-8am weekdays, 24 hours weekends.
ED-RCPM (07) 266 3369. MV. Andrew Waddell. 24 hours daily. V21, V23. User Works node 1.
Electric Dreams (07) 399 1322. MV. Joe Altoff. 24 hours daily. V21, V23. User Works node 5.
Focus (07) 285 5814. MV. Geoff Ryan. 24 hours daily. V21, V23. User Works node 6.
Hi-Tech (07) 38 6872. Clyde Smith-Stubbs. 24 hours daily.
Kangaroo Point TAFE (07) 393 1763. Troy O'Malley and Tim Mansfield. 9am-10pm weekdays, 24 hours weekends. V21, V23.
Ozforum (07) 209 4294. M. Greg Noonan and Kirk Vanbruggen. 4pm-7am weekdays, 24 hours weekends.
RALF (07) 344 1431. Jon Morgan. 24 hours daily. V21, V23. FidoNet.
RApple-Q (07) 284 6145. Graham Black. 24 hours daily. V21, V22, V22bis, V23.
Soft-Tech (07) 203 6864. P. Alwyn Smith. 24 hours daily. V21, V22, V22bis, V23, and Bell.
Software 80 (07) 369 7103. MV Tony Melius. 7.30pm-8am weekdays, 2.30pm Saturday-8am Monday. V21, V23.
Tomorrowland (07) 394 2300. Darryl Lewis. 24 hours daily. V21, V23.
Vortex (07) 396 4655. Gary DeNooyer. 9pm-7am daily.
CAD (070) 51 1360. Neil Barker. 24 hours daily. V21, V22, V22bis, V23 and Bell.
Mackay High (079) 514 815. P. 4pm-7.30am weekdays, 24 hours weekends.
SVI (075) 46 3252. MV. Brendan Pratt. 24 hours daily.
Toowoomba Computer Centre (076) 32 7542. 6pm-8am weekdays, 24 hours weekends.

SA

Adelaide Micro Users Group (08) 271 2043. MV. Richard Newcombe. 24 hours.
Adelaide Microbee (08) 212 6569. Ron Carson and Mark Hammond. 6pm-8am Monday-Thursday, 9pm Friday-8.30am Monday.
The Electric Oracle (08) 260 6222. MV. Don Crago, Grayham Smith. 24 hours daily. V21, V22, V22bis, V23.
IDN (08) 352 2252. MV. Dave Winfield. 5.30pm-9am weekdays, 24 hours weekends. V21, V22.
Multiple (08) 255 5116. MV. Danny Vosso. 9pm-9am daily. V21, V22, V22bis, V23.
Nexus (08) 243 2477. M. 24 hours daily.
Omen V (08) 332 4631. MV. Richard Siggs. 24 hours daily.
SAC 64 (08) 371 0435. MV. Peter Hinton. 24 hours daily.
Trivia (08) 377 0049. Daron Ryan. 6pm-8am weekdays, 2pm Saturday-8am Monday.

NT

Omen II (089) 27 4454. Terry O'Brien. 24 hours daily.
Outback (089) 27 7111. Phil Sampson. 24 hours daily.
Telepack (089) 52 8852. Mark Little. 24 hours daily. V21, packet radio.

WA

Apple Board (09) 378 3258. Mazi Maniei. V21, V22, V22bis, V23.
Computext (09) 447 0522. Russell Stokes. 24 hours daily.
The Gathering (09) 272 4711. Ken Peters. 24 hours daily. V21, V22, V23.
Mouse Exchange (09) 339 6890. Leonard Hollings. 24 hours daily. V21, V22, V22bis, V23, Bell 2400. FidoNet 690/901.
NEMO (09) 370 1855. Graeme Platt. 24 hours daily. V21, V22, V23.
Oasis (09) 384 8431. MV. V21, V22.
Omen III (09) 249 1555. Greg Watkins and Nigel Read. 24 hours daily. V21, V23.
Perth PC Users (09) 227 9229. 24 hours daily.
The Programmers Exchange (09) 274 6851. Matthew Corica. 7pm-7am weekdays, 24 hours weekends.
Streamline (09) 387 8097. Ismael Yahya. 6pm-1.30am, 3.30am-9am daily. V21, V22, V22bis, V23.
Student Access Message Service (09) 321 9721. MV. Peter Walton and John Bramley.
Z-Node 62 (09) 450 0200. Lindsay Allen. 24 hours daily.
Kalgoorlie College RCPM (090) 21 7755. P. 24 hours daily.

Tas

Tassie Bread Board System (003) 26 4248. MV. Ian Campbell. 24 hours daily. V21, V22, V22bis, V23.

END

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AD INDEX

50.5 MBytes
5¼" Half-Height Disk Drive

3650

- **Based on MiniScribe's 3000 family of 5¼-inch half-height disk drives.**
  - **Field-proven rack and pinion actuator provides positioning accuracy throughout temperature extremes**
- **50.5 MByte (unformatted)**
- **61 msec. average access time**
- **Self-regulated head parking feature**
- **Tri-colored LED**
- **Product family growth to higher capacities**
- **Industry standard ST412 interface**

Responding to the demand for a higher capacity, cost-effective, 5¼-inch half-height disk drive with increased performance, MiniScribe has met the challenge with its new model 3650. Based on MiniScribe's rugged 3000 family of 5¼-inch half-height Winchester disk drives, the 3650 is an innovative three disk, six head, 50.5 MByte configuration with an average access time of 61 milliseconds.

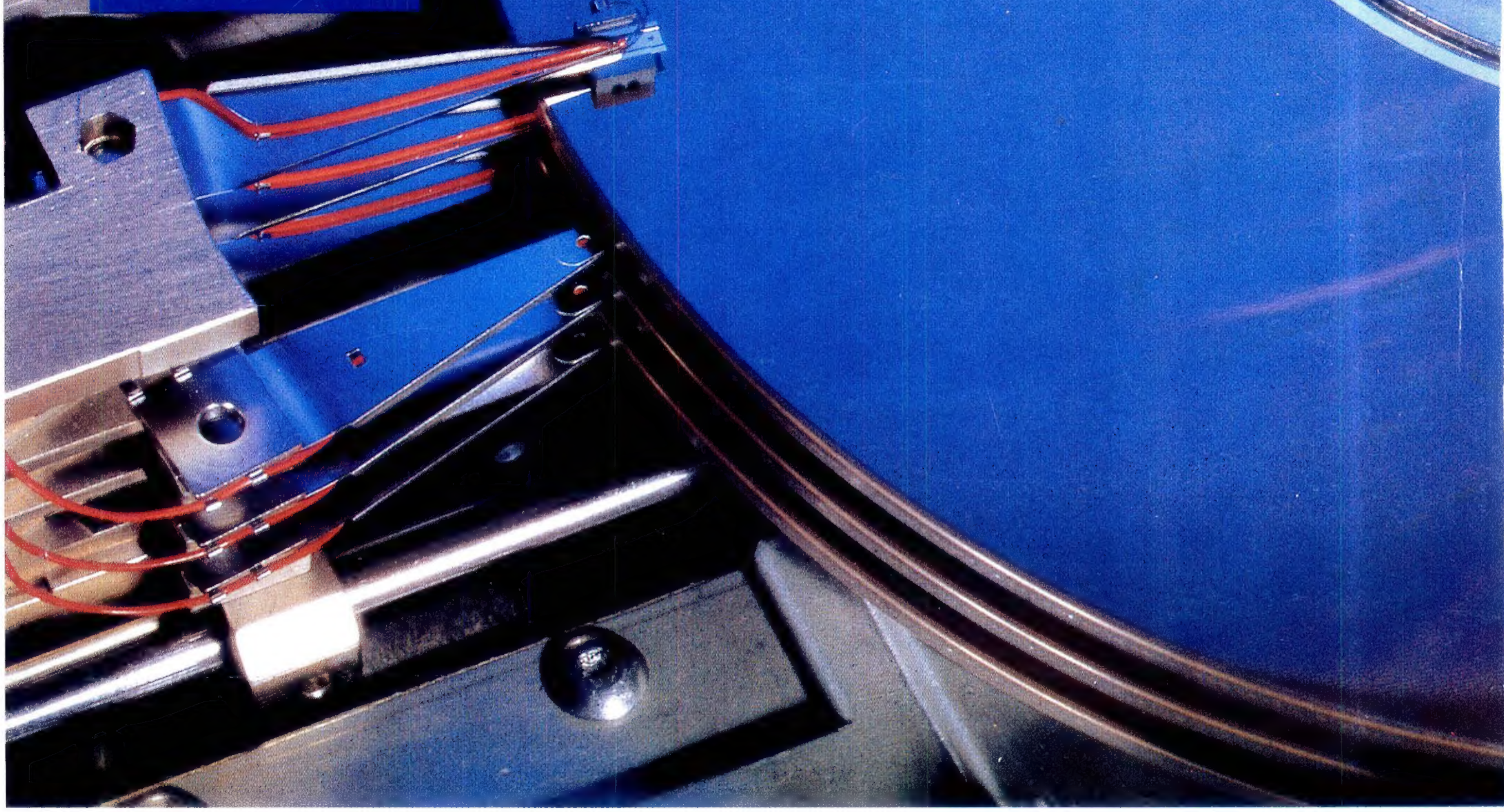
The 3650 features a tri-colored LED which allows the operator to view various operational phases of the disk drive by displaying a green light during normal operation, a blinking red light for error codes and an amber light while the heads are parked at the landing zone.

Another innovative feature of the 3650 is the self-regulated head parking feature which will automatically park the heads at the landing zone after 30 seconds of inactivity to insure the operator that the heads are parked in a nondata area.

Like other MiniScribe products, the 3650 incorporates the company's high standards of quality and innovation. The 3650 utilizes MiniScribe's field-proven rack and pinion linear actuator system which provides positioning accuracy throughout temperature extremes as well as rugged resistance to shock and vibration. In addition, the drive incorporates the industry standard ST412/506 interface.

With planned enhancements to higher storage capacities, the 3650 demonstrates MiniScribe's technical leadership by delivering one of the most favorable cost per megabyte solutions for your current and future storage requirements.

In addition to the 3650, MiniScribe produces a complete line of 3½-inch and 5¼-inch Winchester disk drives which begins at 12.75 MBytes, extends to high capacity, high performance models, and includes a variety of standard, intelligent and custom interfaces.



MiniScribe